THIRD EDITION

VAULT CAREER GUIDE TO

INFORMATION TECHNOLOGY

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Introduction by Stephen Ibaraki

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Introduction

Where did I begin and how did I build my career? What advice can I share? What are the career trends and employment outlook?

Let’s start with the last question. Computing is fundamentally embedded everywhere and essential in government, business, industry, research, and all domains of science, academia, media, and society. Recently when I was invited to speak at the United Nations General Assembly in New York, pervading all the discussions was the fact that information communication technology (ICT) underlies the success of the United Nations Sustainable Development Goals for all countries until 2030 and the World Summit on the Information Society’s goals (called action lines). Thus, ICT has unbounded opportunities for you, your career, and employment. There is only one catch. You have to stay current and keep your eye on upcoming innovations by actively participating, taking on new challenges, and studying/reading continuously. For example, pulling from my own experiences, a practical way is to become a Microsoft Most Valuable Professional (MVP) awardee by studying independently and then sharing expert volunteer services. As a coveted MVP, you get access to the latest technologies and insights to future trends. You also could join and participate in one of many national and international nonprofit organizations such as the Association for Computing Machinery, which offers its digital library, mentoring, publications, conferences, courses, videos, books, webinars, special interest groups, and much more. Staying current and keeping an eye on future trends is not hard; it just takes your commitment and time.

Now let’s address the first two questions.

Raised on a farm I always had an interest in science from the age of four, reading encyclopedias, and playing with a microscope. Whatever small amount of money I had, I spent on science, building my first analog computer at 10 and then building electronic analog and digital circuits, including a digital computer, after that. My family always

encouraged me to explore new ideas, ask questions, believe anything is possible, respect others, and be inclusive—habits that are a foundation for success and ones that I advocate today.

My first professional exposure to computing equipment was in a fast food chain that had a digital ordering system—the first of its kind. This was in the 1970s. They flew a technician in at C$100/hour whenever there was a problem. I figured I could provide considerable savings and do the same or better work repairing the equipment in return for free food and C$25/hour, an offer the owners accepted. This highlights the career advice of always looking proactively to make a business case for how you can do a better job and one where you will learn and grow.

At one point still very early in my career, I had five concurrent work roles including data processing manager with the largest data processing company, writing the first syndicated column about computers for a series of newspapers, evenings/weekends with another company where I developed a new sensing device, teaching the college's first extension courses on computers, and proposing a radio show, as well as founding the first computer club, writing a business plan and then directing a new division of a company which became my first successful exit. This points to the career advice of taking on stretch goals—those out of your comfort zone. In addition, you don't always have to see the end of your journey but the next steps forward—this stepwise refinement towards your goals will help you conquer them. I recommend having a 180-day window where you look back 90 days to see where you are in your goals, 90 days forward to see how to take the next step in your goals, and you do this weekly. The key is that you always set goals and are making agile adjustments. Some of these roles paid for my postsecondary education (where I graduated after studying science, engineering, and accounting), and other roles were to contribute to the community and advance the profession. Now late in my career, I find the top people in technology do both; they have paid roles and they donate time. So, my next advice to you—do both; you will learn much from your donated time and especially by working towards leadership positions.

At the data processing company, I started on the technical side. I was a data processing manager, systems analyst, national products manager, and head of a division. I was invited to write a business plan (my first without knowing how to write one), wrote scores of technical papers, wrote a sales/marketing guide, authored an industry strategy guide which set the direction of an entire sector worth billions for 10 years, and much more. Each task represented something I had not done before—again, I recommend always embracing new opportunities. The work for the data processing company provided a skill set that I use today.

Regarding my role in sales, I was really shy and knew that I needed to overcome this shyness to do more. So, I asked to go into sales. “Are you crazy, you have a great career on the technology side?” I was told. Armed with a course on sales, I bet my manager I could make my first sale in the first week. I won the bet, became a top salesperson, and that year won a national All-Star Team award for all of my work as top data processing manager/systems analyst/salesperson and for a device I created to improve the efficiency of our data center.

In sales, I learned the importance of focusing on providing clear value to others and seeing it from their perspective. In each of my sales, I worked as a consultant advising clients on their behalf and advancing their agenda, satisfying their needs. During that time, I was given and invited to direct access to the company president to discuss innovative ideas whenever I did them. An added lesson here is that you look at your perceived weaknesses (shyness, in my case) and take corrective action no matter how difficult it is or how daunting the task.

Though my foundation is technical, the best thing I ever did was go into sales since I learned

- the value of growing strong interpersonal skills
- how to communicate effectively
- the art of building relationships
- the value of diversity in your relationships
- the need to always ask questions and listen intently
- how active observations of your total environment and all stakeholders in it create differentiation and competitiveness

- the need for trying ideas out with minimal investment
- how to connect the dots from your various experiences
- project management skills
- how to understand the fundamentals of the business/industry
- how to grow a positive approach or attitude
- technical mastery
- writing skills

Thus, the next piece of advice; you need to think carefully about each of these points and practice them to be successful.

I also discovered that every role has its best practices and if you learn them, you can master the role—and this applies to everything. A good example is sales. Though a rookie, I outsold others since I put the best sales practices from the sales course into action. Later on when I went into teaching full-time, I won the best teaching award in my first year since I studied the best professors and completed a course on effective teaching—I put these lessons into practice and they worked. This stays true for everything I have done in my career and I have received awards in each area. Find the secret sauce, the best practices for the role, and then use them.

Though not a professional speaker and shy, I spoke frequently at regional events to overcome this skills challenge. Finally, I received an invitation to be the keynote speaker at a national conference for an entire industry and wrote a 400-plus page futuristic, multi-year strategy guide to convert the billion dollar industry to focus on computing. To prepare for my first time speaking at this scale, I studied the best practices and I took it on. It was a big hit. During this same period, I converted the largest atomic energy company in the world towards microcomputers, designing their hardware configurations, networks, communications, databases, all areas of software, plus the first implementation of artificial intelligence (in the 1980s).

There are many other examples like this. I then got into full-time teaching at various colleges/universities/institutes at the same time to give back, creating the first industry/academic programs that garnered international recognition and also represented a multi-million dollar startup and first client/server lab in the country. My speaking opportunities went global after that and I started taking on leadership roles with companies, ICT

organizations, and global forums, in addition to donating time with nonprofits. In addition, I created many platforms for companies such as Microsoft, raising capital for them and then having them absorbed into the companies, generating billions in revenue. This continued my startup successes.

As a venture capitalist, I now work with start-ups, entrepreneurs, investments, and innovation and encourage people in this direction. We are always looking for great new ideas and startups. Don’t be afraid to try; the key is to take action and not just talk or wait till something is perfect. I call this going past perfection or inaction paralysis. I am always on the lookout for stagnation; if I am too comfortable—not feeling challenged—then proactively I seek to learn more and take on new challenges. That is the only way you can grow.

The last tip I will give you is to carefully study this book *The Vault Career Guide to Information Technology*, which describes the industry and careers. You will learn a lot to begin your career with the proper boost.

—Stephen Ibaraki is a multiple-award-winning educator, researcher, speaker, writer, serial entrepreneur, and executive board chairman/board director/advisor for corporations, investment groups, federations, associations, societies, and educational summits in the field of information technology.

About the Authors

Andrew Morkes is a freelance writer and editor in Chicago, Illinois, who has been writing about college- and career-related topics for more than 25 years. He is the founder of College & Career Press, the editorial director of the *CAM Report* and *College Spotlight*, and the author of The Morkes Report: College and Career Planning Trends blog. Andrew has written and edited many books for Ferguson's including the *Encyclopedia of Careers & Vocational Guidance*, the *Vault Career Guide to Accounting*, and many volumes in the *Careers in Focus*, *Discovering Careers*, and *Career Skills Library* series. He is also the author of *They Teach That in College!?: A Resource Guide to More Than 100 Interesting College Majors and Programs*, which was selected as "A Perfect Ten" by the library journal *Voice of Youth Advocates*, and *Nontraditional Careers for Women and Men: More Than 30 Great Jobs for Women and Men With Apprenticeships Through PhDs.* Andrew is a member of the parent advisory board at his son's school. His poetry has appeared in *Cadence*, *Wisconsin Review*, *Poetry Motel*, *Strong Coffee*, and *Mid-America Review.*

Stephen Ibaraki *is a multiple-award-winning educator, researcher, speaker, writer, serial entrepreneur, and executive board chairman/board director/advisor for corporations, investment groups, federations, associations, societies, and educational summits in the field of information technology (IT). He has held more than 100 top executive roles and served in a variety of other positions in the IT industry, including co-chair, Association for Computing Machinery (ACM) Practitioner Board and member of the ACM ext-council, ext-executive committee; founding chair, Global Industry Council; vice-chair board, International Federation for Information Processing; top 5 blogger IDG-IT World (Canada); founding managing general partner, REDDS Venture Investment Partners; founding chairman investment committee, REDDS VC Fund; founder, technology advisory board, Yintech Investment Holdings Ltd. (NASDAQ); founding member, Beyond Initiative (VW/Audi AI Think Tank); founding chairman outreach, United Nations (UN) ITU "ICT Discovery" Journal; founder and chairman outreach UN International Telecommunication Union AI for*

Good Global Summit with XPRIZE Foundation; keynote speaker at the International Conference on Software Engineering (ICSE Austin USA); keynote speaker, United Nations Industrial Development Organization General Conference Industry 4.0 (Vienna); organizer and host speaker, Wuzhen Summit World Internet Conference Artificial Intelligence Forum; speaker, UN General Assembly Second Committee & United Nations Economic and Social Council Joint Session (New York, Future of Everything); founding chairman, Technology Advisory Council, Financial Services Roundtable, FinTech Ideas Festival; founding chair, advisory board and keynote Digital Africa on Industry/Nation 4.0 (2016, 2017); and invited advisor on Nation 4.0 and board member within Institute of Electrical and Electronics Engineers. Stephen has received more than 300 "lifetime and career" achievements and awards for disruptive innovation, futuristic investments, successful entrepreneurship, and global technology leadership. He has received 18 global Microsoft Awards, including 15 Microsoft MVP Awards.

The Basics

Overview

CompTIA, a major information technology (IT) industry trade association defines IT as the “utilization of computing via hardware, software, services, and infrastructure to create, store, exchange, and leverage information in its various forms to accomplish any number of objectives. Additionally, the term encompasses the workers that develop, implement, maintain, and utilize IT directly or indirectly.” Key elements of information technology include:

- **Hardware:** computers, servers, storage, tablets, mobile phones, printers, network equipment
- **Software:** productivity and business applications, network and security applications, mobile apps, video games, cloud computing, virtual reality
- **Services:** deployment, integration, custom development, repair/upgrade, managed services
- **Infrastructure:** Internet backbone, telecommunications networks, cloud data centers
- **Information:** data, documents, voice, video, images
- **Business Objectives:** commerce, production, communication, collaboration

Approximately 12.1 million workers were employed in technical and nontechnical positions at IT firms and at companies, nonprofits, and government agencies that had IT departments in 2019, according to CompTIA, an industry association. This number also included self-employed IT workers who worked full time.

Information technology jobs are found throughout the United States and the world. CompTIA reports that the top five states for IT worker employment are California, Texas, New York, Florida, and Virginia. Within certain states there are also employment clusters such as Silicon Valley in California and Seattle, Washington. IT employment opportunities vary by industry segment. Within the hardware and software branches of the computer

industry, many positions overlap and not every company will hire people to fill positions in each basic occupational segment: design, programming, administration, sales, and service.

It's important to keep in mind that there is a large number of IT jobs outside the tech industry. Nearly every sector—from manufacturing and retail, to pharmaceutical research and banking—have a need for IT professionals. The analytics software company Burning Glass reports that only two IT companies (Amazon and IBM) were included on its list of the top 10 companies that hired software developers and engineers in 2019. Non-IT companies on the list included U.S. Bancorp, JP Morgan Chase, Northrop Grumman, General Dynamics, Booz Allen Hamilton, Accenture, Raytheon, and Capital One.

The U.S. Department of Labor projects annual employment growth of 11 percent for computer and information technology careers through 2029. Some of the fastest-growing jobs include information security analysts (+31 percent), software developers (+22 percent), computer and information research scientists (+15 percent), and Web developers (+8 percent).

To succeed in this field, IT professionals need strong analytical and problem-solving skills, flexibility, a minimum of a bachelor’s degree (for most positions), the ability to keep up with the latest technology, and a solid understanding of computers, the Internet, and IT basics. However, the technology of today may be obsolete in months, if not weeks, and only those individuals who work to remain on the cutting edge will have long-term growth potential during their career.

Contrary to the stereotype, the industry isn’t merely for pasty-skinned nerds, but it welcomes workers with a wide range of personality types, from techies and creatives, to those with sales-or customer service–oriented personalities. Historically, salaries have been generous (computer and math professionals earned mean annual salaries of $88,240 in May 2019, according to the U.S. Department of Labor), and the possibility of making a mint in stock options is an especially delicious bonus for those brave enough to sign on with an unproven startup.

Few other career paths can present what technology jobs offer—meritocracy, high salaries, teamwork, and intellectual fulfillment. Information technology careers typically rank high in "best job" lists due to their combination of good pay, relatively low stress levels, challenging work, advancement possibilities, and strong employment demand. In 2020, 12 of the top 100 jobs on *U.S. News & World Report's* best careers list were in IT or related areas (such as data analytics), including software developer (#1), statistician (#6), IT manager (#12), mathematician (#14), operations research analyst (#20), Web developer (#23), database administrator (#30), information security analyst (#38), computer systems analyst (#53), computer network architect (#60), computer systems administrator (#63), and computer support specialist (#98).

Primary Products and Services

The information technology industry can be divided into six broad sectors: hardware, software, content (entertainment and information), services, infrastructure, and business objectives.

Hardware

Hardware firms produce every piece of equipment used to build a computer system. This includes the equipment inside a computer, such as memory chips, microprocessors, network cards, and motherboards. It also includes the equipment mostly found outside the computer, called peripheral hardware, such as keyboards, monitors, printers, external hard drives, scanners, and digital cameras.

Internal hardware makes the difference between a slow, hard-to-use computer and cutting-edge technology. Memory chips store data and programs, while processors follow program instructions to manipulate the data in a desired manner. For example, when a secretary uses a word processor to type letters, the microprocessor transforms the keyboard input into electrical impulses that are stored on the memory chips. Many companies specialize in improving the speed, accuracy, and overall quality of these devices.

Secondary storage devices, such as flash drives and external hard drives, are used to store information and transfer it physically to another computer location. Hard drives hold a tremendous amount of information.

Input devices are another type of hardware and include keyboards, scanners, and video cameras. Scanners read printed material (such as photographs) and convert it into electrical impulses to be stored in the computer. Then, systems operators can change them in any way desired. They can also use them to prepare formal presentations in different media, including video or PowerPoint presentations.

Output devices, such as a monitor or screen, allow users to access and change data and information. Some television manufacturers specialize in making monitors with higher resolution and better graphics capabilities so that more complex applications can be run and displayed successfully on the systems. Another output device is a printer. Dot matrix printers of the early 1980s soon gave way to ink jet printers, bubble jet printers, laser printers, and now 3D printers. Most printers for PCs are now capable of printing in color or black and white, and many function as scanners, copiers, and fax machines, as well. Many printers have wireless capabilities so they can work with multiple devices on a shared network.

Communications devices, such as modems, enable computers to connect to other systems via cables or telephone lines. The modem allows the transfer of information between computers. Wireless broadband allows fast access to data on the Internet via a home or business Wi-Fi system or a wireless data signal for mobile devices. Internet service providers provide access to the Web via high-speed cable or DSL connections and, in rare cases, through dial-up phone connections. In 2019, 73 percent of Americans who used the Internet had a broadband connection, according to the Pew Research Center, up from 42 percent in April 2006.

Software

Software design and programming are vital roles in the computer industry. Without detailed, precise programs, computers would be useless since they only do exactly what they are told to do. Several programs are necessary to make computers operate properly.Common types of software include:

- operating systems (Windows, Android, IOS)
- word processors (Word, WordPerfect)
- spreadsheets (Excel, Sheets, Numbers)
- presentation software (PowerPoint)
- database management systems (Access, Oracle, HANA)
- photo and video editing (Photoshop, PhotoPaint, GIMP)
- games (Legend of Zelda, Super Mario, Call of Duty)
- desktop publishing (InDesign, QuarkXPress)
- computer-aided design software (AutoCAD, DesignCAD, SolidWorks)

- e-mail clients (Outlook, Google)
- Web browsers (Internet Explorer, Chrome, Firefox, Safari)
- security (Norton, McAfee, Kaspersky, Avast)
- virtual/augmented/mixed reality (Sony, Facebook, Google, HTC)
- cloud computing (Microsoft, Amazon, IBM, Salesforce.com, SAP)

Content

The content sector consists of information and entertainment that is accessed mainly via the Internet (through desktop computers, smartphones, tablet computers, and other devices), but also through CD-ROMs and other external storage devices. Such content includes text (blogs, social media sites, online and downloadable books and magazines, news sites, etc.), video (YouTube, Netflix, Amazon Prime, Disney+, etc.), audio (Apple Music, Pandora, Spotify, Tidal, etc.), animation, images, video games, and paid advertising. Some Web sites provide many or all of these types of content. Today, the amount and variety of content available on the Internet is awe inspiring, and many people are willing to purchase access to stream or download digital content. Common Internet services include e-commerce sites (offered by both brick and mortar companies such as Wal-Mart and online-only firms), as well as online education, e-mail, maps and directions, product review, social media, and video-conferencing sites, among many others. In 2019, 90 percent of U.S. adults used the Internet, according to the Pew Research Center. Only 52 percent of Americans were online in 2000.

Services

Information technology services that fall under this category include systems design, software support, system integration (e.g., merging an old e-commerce system with a new one), computer and data processing facilities management, troubleshooting and repair of faulty software and hardware, user support to employees and customers, the design of proprietary computer systems and software, and securing company systems and sensitive data against hackers and industrial espionage.

Infrastructure and Business Objectives

The infrastructure sector consists of the hardware and software (including databases, networks, and payment-processing systems) that are used to build and operate the Internet, telecommunications networks, and cloud data centers (on-premise hardware that houses cloud services and cloud-based resources and stores data within an organization's local network). The related business objectives sector consists of hardware and software that help businesses sell goods and services online, manufacture and deliver products, and oversee various facilities and departments. It also relates to the software that employees of a business or organization use to communicate within company Intranets, as well as collaborate on the cloud.

Uppers and Downers

Uppers

- Tech is cool. It’s fun to be on the cutting-edge of technology and help design and build the next iPod, app, or smartphone.
- A fast-growing industry. Strong employment demand is predicted for many IT occupations. For example, the U.S. Department of Labor (DOL) reports that employment for information security analysts will grow by 31 percent through 2029. Job opportunities for software developers will increase by 22 percent during this same time span.
- Career diversity. Opportunities are available for techies, creative types, communicators (sales, marketing, social media), and people with almost any type of skill set and personality type. There are many opportunities to transition to other careers in the field.
- Good pay. Those employed in computer and mathematical careers earned mean annual salaries of $88,240 in May 2019, according to the DOL. This is much higher than the mean salary for all occupations, $53,490. Additionally, if you get in on the ground floor of a promising start-up, you might get a big payday if the company goes public.
- Geographic freedom. Opportunities are available throughout the United States and all over the world. Some positions allow you to work from home.
- Happy workplaces. Many tech companies have a reputation for offering fun, laid-back work environments (and excellent perks). More than 15 tech companies were featured on CareerBliss.com’s recent list of the “50 Happiest Companies in America,” including Google, Intuit, Qualcomm, Microsoft, Cisco Systems, Oracle, Samsung, and Apple. Seventy-two percent of information technology professionals surveyed by the IT and professional training firm Global Knowledge in 2019 reported being satisfied with their jobs.
- Great perks. Top companies offer excellent benefits such as free fitness classes and meals, paid sabbaticals, on-site medical care, paid maternity and paternity leave, and complete medical/dental benefits.

Some perks are just plain fun. Health care tech giant Epic Systems has a tree-house conference room, a moat, and an Indiana Jones-themed tunnel at its corporate headquarters.

Downers

- Limited job security. The tech industry is constantly expanding, contracting, and restructuring. Some U.S.-based jobs are being outsourced to foreign countries.
- Constant deadlines. When on deadline, you may have to work long hours, including at night and on weekends.
- Constant learning. Since technology changes constantly, you'll need to stay up to date throughout your career by attending continuing education classes, as well as by renewing your certifications or earning new, in-demand credentials.
- Unhappy workplaces. Some tech companies have a reputation for being stressful places to work at because of unrealistic expectations by managers, excessive work hours, or sexual and ethnic discrimination.
- Sedentary work environment. Many jobs involve a lot of time in front of a computer.
- Fewer opportunities for some ethnic minorities. Large companies such as Alphabet, Apple, Facebook, Microsoft and Twitter, and the industry on the whole, are making efforts to improve ethnic diversity, but progress has been slow. From 2014 to 2020, there have only been low single-digit increases in their percentage of Black employees, according to a CNBC analysis of the annual disclosures of these companies. For example, the number of Black employees at Twitter only increased from roughly 2 percent in 2014, to 6 percent at the start of 2019.
- It's a man's world. Women made up only 25 percent of those in computer occupations in 2018, according to the U.S. Department of Labor. Women are underrepresented in most tech occupations. For example, in 2019, only 18.7 percent of software developers were women, according to the DOL, despite the fact that women comprise 46 percent of the U.S. workforce. This gender imbalance sometimes creates uncomfortable or even hostile work environments for women.

One bright spot: women made up 41.4 percent of web developers and 40.1 percent of computer systems analysts in 2019.

History

Background

Developed in Asia and widely used during the Middle Ages, the abacus can be considered the origin of modern computing devices. An abacus, composed of strings and beads representing numerical values, can be used for arithmetic.

French philosopher Blaise Pascal invented the world's first digital calculator in the 17th century. His machine was based on a system of rotating drums controlled with a ratchet linkage. In honor of his early contributions to computer technology, the programming language Pascal was named after him in the 1970s. A German philosopher and mathematician, Gottfried Wilhelm von Leibniz, later improved Pascal's design, making a handheld version similar to a handheld calculator. It never became available commercially, however.

The first significant automated data-processing techniques were applied to making fabric patterns, not calculating numbers. French weaver Joseph-Marie Jacquard introduced a punch-card weaving system at the 1801 World's Fair. His system was straightforward enough; the punched cards controlled the pattern applied to the cloth as it was woven. The introduction of these looms, symbolizing the replacement of people by machines, caused riots.

After proposing in 1822 that it might be possible to compute table entries using a steam engine, Charles Babbage had second thoughts about his idea and went on to design the analytical engine that had the basic components of the modern computer in 1833. This earned him the title of father of the computer. He was aided greatly by the daughter of famous poet Lord Byron, Ada Augusta King, Countess of Lovelace, who is recognized as the world's first programmer. In 1890, U.S. inventor and statistician Herman Hollerith put the punched card system to use for the 1890 census. He discovered that perforated cards could be read electrically by machines. Each perforation could stand for some important piece of information that the machine could sort and manipulate. Hollerith founded the Calculating-

Tabulating-Recording Company in 1914, which eventually was renamed International Business Machines (IBM) in 1924. IBM is still an IT industry leader today, and it remains on the cutting-edge of technology. Some of its newest projects focus on blockchain technology, data analytics, artificial intelligence, and other emerging fields.

In the mid-1940s, punched cards were also used on the Electronic Numerical Integrator and Calculator (ENIAC) at the University of Pennsylvania. ENIAC's inventors developed the world's first all-electronic, general-purpose computer for the U.S. Army. This computer was enormous and relied on over 18,000 vacuum tubes. In 1949, they introduced the Binary Automatic Computer (BINAC), which used magnetic tape, and then developed the Universal Automatic Computer (UNIVAC I) for the U.S. census. The latter was the first digital computer to handle both numerical data and alphabetical information quickly and efficiently. In 1954, IBM built the first commercial computer, the 650 EDPM, which was programmed by symbolic notation.

By the late 1950s, the transistor, invented 10 years earlier, had made the second generation of computers possible. Transistors replaced the bulky vacuum tubes and were lighter, smaller, sturdier, and more efficient.

The integrated circuits of the late 1960s introduced the solid-state technology that allowed transistors, diodes, and resistors to be carried on tiny silicon chips. These advances further reduced operating costs and increased speed, capacity, and accuracy. Minicomputers, much smaller than mainframes (large-scale computers) but of comparable power, were developed shortly afterward.

The next important advances included large-scale integration and microprocessing chips. Microchips made even smaller computers possible and reduced costs while increasing capacity. The speed with which a computer processed, calculated, retrieved, and stored data improved significantly. Decreased costs allowed manufacturers to explore new markets.

In the mid-1970s, Steve Wozniak and Steve Jobs started Apple out of their garage. Their vision was to bring computers into every home in America

and even the world. Toward that end, they developed a user-friendly computer offered at a reasonable price. User-friendliness was essential, since many people without computer skills would have to adapt to the computer system. The development of their eventual product, the Macintosh computer, was the first to give on-screen instructions in everyday language and successfully use a graphical interface. In addition, Apple introduced the mouse, which allows users to point and click on screen icons to enter commands instead of typing them in one by one.

IBM and manufacturers who copied their designs were quick to enter the personal computer (PC) market once they recognized the tremendous sales potential of the device. The result was a friendly debate among computer users over which are better—Macs or PCs. Regardless of personal preference, the two incompatible systems often led to problems when people tried to share information across formats. Software designers have since developed ways to make file conversions easier and software more interchangeable.

One major trend of the last few decades was the downsizing of computer systems, replacing big mainframe computers with client-server architecture, or networking. Networks allow users greater computing flexibility and increased access to an ever-increasing amount of data.

The second major recent trend has been the rapid growth of the Internet and World Wide Web. Initially developed for the U.S. Department of Defense, the Internet is composed of numerous networks connected to each other around the world. Not surprisingly, this massive network has revolutionized information sharing. It’s used for real-time video conferencing, e-mail services, online research, social networking, e-commerce, online education, entertainment, and many other purposes. The World Wide Web usually refers to the body of information that is available for retrieval online, while the Internet generally refers to the back-end network system plus its various services. In recent years, Internet use on handheld and tablet devices and through wireless networks has revolutionized people's access to technology. As of September 2020, there were more than 1.8 billion Web sites and more than 4.6 billion Internet users, according to InternetLiveStats.com. Approximately 8 percent of users lived in North America.

Hardware companies are continually striving to make faster and better microprocessors and memory chips. Advances in hardware technology have led directly to advances in software applications. As the developer of Windows, Microsoft has been the leader in the software industry. Windows is a user-friendly, visual-based operating system. (An operating system is the interface between the user, the programs stored on the hardware, and the hardware itself.) Disk operating system (DOS) is one of the early operating systems, and while still used, it requires more computer knowledge than other operating systems. The Windows and Mac systems allow users to point and click on icons and menus with a mouse to tell the computer what to do, instead of having to type in specific commands by hand, as DOS requires.

Intel and Motorola have been the innovators in microprocessor design, striving for faster and more efficient processors. Such innovations allow computer manufacturers to make smaller, lighter, and quicker computers, laptops, and handheld models. As processors get faster and memory increases, computers can process more sophisticated and complicated software programming.

Two fast-growing trends are cloud computing and mobile computing. Cloud computing allows computer users to store applications and data in the "cloud," or cyberspace, on the Internet, accessing them only as needed from a compatible tablet, handheld, or notebook computer. The International Data Corporation, a market research, analysis, and advisory firm, reports that the worldwide public cloud services market reached $233.4 billion in 2019—up from $160 billion in 2018 and $45.7 billion in 2013. The market is projected to grow at a compound annual growth rate of 22.5 percent through 2022. Mobile computing has led to a boom in smartphones or handheld computers supported by Wi-Fi technology that allows users to access the Internet and cloud content and programs from anywhere they receive a Wi-Fi signal. In 2020, 51.5 percent of the global online population accessed the Internet from their mobile phones, according to Statista, an Internet statistics firm. This percentage is expected to grow to 72.6 percent in 2025, according to a report by the World Advertising Research Center, using data from mobile trade body GSMA. These trends are key factors driving the evolution of computing devices and the Internet today.

Other major IT trends include the growing use of the following technologies:

- Blockchain: a distributed ledger database (similar to a relational database) that maintains a continuously-growing list of records that cannot be altered, except after agreement by all parties in the chain.
- Artificial Intelligence: a concept that machines can be programmed to perform functions and tasks in a “smart” manner that mimics human decision-making processes; and
- Machine Learning: a method of data analysis that incorporates artificial intelligence to help computers study data, identify patterns or other strategic goals, and make decisions with minimal or no intervention from humans.
- Quantum Computing: a type of advanced computing in which quantum computers are used to solve challenges of massive size and complexity that cannot be solved by the computing power of traditional computers. “Quantum computers could spur the development of new breakthroughs in science, medications to save lives, machine learning methods to diagnose illnesses sooner, materials to make more efficient devices and structures, financial strategies to live well in retirement, and algorithms to quickly direct resources such as ambulances,” according to IBM. Companies such as Google, Intel, Microsoft, and IBM are making significant financial investments in quantum hardware and software. The research and advisory firm Gartner, Inc. predicts that 20 percent of organizations will be budgeting for quantum computing projects by 2023, up from 1 percent in 2019.
- Biometrics: distinctive physical or behavioral characteristics (such as fingerprints, palms, eyes, and faces) that are used to identify individuals. Biometric systems are a set of hardware and software that collect, process, and assess these characteristics and compare them against existing records to create a match. CompTIA says that biometrics “will play an important role in improving security by allowing people and devices to authenticate and move seamlessly through our high-tech world.”

Additionally, virtual reality, augmented reality, and mixed reality technologies are moving far beyond the video gaming industry for use in

the health care, hospitality, training, architecture, and law enforcement industries. Virtual reality (VR) is technology (typically a headset that encompasses the field of vision) that allows users to immerse themselves visually, aurally, and through other sensations in imaginary worlds. Augmented reality (AR) is technology—a special headset or applications on a smartphone or tablet—that introduces virtual objects to the real world. Mixed reality involves a combination of virtual and augmented reality technology in which users can interact with virtual worlds by using real-world objects. The International Data Corporation, (IDC) an American market research, analysis, and advisory firm, predicts that worldwide spending on AR/VR products and services will experience a five-year compound annual growth rate of 77 percent from 2019 to 2023.

The number of AR devices worldwide is expected to increase by 140 percent from 2018 to 2022, according to the market research firm IDC. *PC Magazine* reports that AR revenue should be strongest in the following industries (listed in descending order of revenue) by 2025:

- video games
- health care
- engineering
- life events
- video entertainment
- real estate
- retail
- the military

Many experts believe that AR will eventually become more popular than VR because it has many more real-world uses in the aforementioned areas, as well as in industrial production, training and development, construction, tourism, vehicle navigation, and law enforcement.

Defining Events

Many important events in the history of the information technology industry have made it what is today—the backbone of business, commerce, communication, entertainment, and many other aspects of our society.

Aiken and the Mark I

Howard Aiken was an inventor and professor of applied mathematics at Harvard University. With the help of colleagues at Massachusetts Institute of Technology (MIT), Harvard, and International Business Machines (IBM), Aiken invented the Mark I during the early 1940s. It performed calculations using a combination of electrical and mechanical components and relays (an electrical switch that opens and closes based on another electrical switch), and is considered the first large-scale automatic digital computer. The instruction sequence used to solve a problem—the program—was fed into the machine on a roll of punched paper tape, rather than being stored in the computer.

In 1945, the idea of storing the program within the computer was introduced, based on the concepts of mathematician John von Neumann. The instructions would be stored within a "memory," freeing the computer from the speed limitations of the paper tape reader during execution and permitting problems to be solved without rewiring the computer.

Atanasoff and ABC

John Atanasoff, a professor from Iowa State College, first conceived of the idea of an electronic digital computer in 1930 (the Mark I relied on mechanical and electronic components). The device consisted of a rotating drum on which 1,600 capacitors (pairs of conductors separated by a nonconducting substance) were placed in 32 rows. Each capacitor could be charged positively, indicating a 1, or negatively, indicating a 0. Today's computers operate on the same binary principle.

In the early 1940s, the completed version, the Atanasoff Berry Computer (ABC) was finished. According to Mike Hally, the author of *Electronic Brains: Stories from the Dawn of the Computer Age*, it was “as big as a fridge, weighed a third of a ton, and used more than 300 tubes...and it took 15 seconds to complete an arithmetic calculation.” The device was designed to resolve systems of linear equations, but it was rudimentary, not programmable, and didn’t always work properly.

Mauchly, Eckert, and ENIAC

John Mauchly, a mathematician and physicist, and Presper Eckert, an electrical engineer, wanted to do something bigger and better than what Atanasoff had done. Their goal was to produce a computer that could perform calculations in 10 minutes or less. Thus began work on the Electronic Numerical Integrator and Computer, or ENIAC.

ENIAC is considered the predecessor of most computers in use today. According to Paul Ceruzzi, the author of *A History of Modern Computing*, its purpose was to calculate firing tables for the U.S. Army. (A firing table contains artillery settings, based on both test firings and computer simulations, given a certain set of conditions.) This task “involved the repetitive solution of complex mathematical expressions, [and ENIAC] occupied a room that was 50 feet by 30 feet, contained 18,000 tubes and 70,000 resistors,” and was much like the clichéd image that comes to mind when one thinks of the first computers.

Vacuum Tubes, Transistors, Integrated Circuits, and Microprocessors

ENIAC and other early computers were powered by vacuum tubes, which were big and bulky and tended to burn out. Scientists began looking for an alternative technology. In 1947, experimental physicist Walter Brattain and theoretical physicist John Bardeen used semiconductors to develop the point-contact transistor. Their supervisor, William Schockley, developed the junction (sandwich) transistor, which was more commercially viable. The use of transistors led to smaller, faster, and more versatile components than

were possible with vacuum-tube machines like the ENIAC. The first commercial computer to use transistors was developed in 1957 by Seymour R. Cray, a pioneer in the design of supercomputers. Because transistors use less power than vacuum tubes and have a longer life, this development alone was responsible for the improved machines called second-generation computers, the first generation being those that employed vacuum tubes. Components became smaller, as did the spacings between components, and systems became much less expensive to build.

The use of transistors revolutionized the computer industry, but the invention of the integrated circuit sent the industry into overdrive. In the late 1950s, two inventors (Jack Kilby, an engineer at Texas Instruments and Robert Noyce, the cofounder of Fairchild Semiconductor Corporation) working separately (and unaware of each other's activities) developed the integrated circuit, or microchip, which combined transistors, resistors, and capacitor into a single chip. This invention reduced operating costs and increased capacity, speed, and accuracy. In 1959, both Texas Instruments and Fairchild Semiconductor Corporation applied for and received patents on this new technology. After several years of legal battles, the two companies decided to cross license their technologies. In 1961, the first commercially available microchips became available. Soon after, all computers were built using microchips. In 2019, the global microchip market was worth more than $412 billion, and microchips are used in every electronic product. Intel is the largest semiconductor chip maker.

In the late 1960s, the invention of the microprocessor, which allowed for thousands of integrated circuits to be built single silicon chip, further revolutionized the IT industry. The Intel 4004 chip, developed in 1971, was the first microprocessor. This technology was integrated into the first desktop computers for home users in the 1980s. These small computers became increasingly powerful, and scientists began to see the possibilities of linking these systems together and sharing information. This was the early stirrings of the World Wide Web.

The Birth of the Internet

The Internet as we know it today began life in the 1960s as a U.S. Department of Defense project called ARPANET (Advanced Research Projects Agency Network). The goal was to create a comprehensive, indestructible computer network that could communicate even when under enemy attack. It used packet-switching technology (a message delivery technique) and TCP/IP (a communications protocol) to communicate. ARPANET started out as a military-only resource, but it gradually expanded as computer professionals, scientists, companies, and others began to see the possibilities for this digital internetwork. By 1995, commercial users dominated all other users, such as military, educational, and scientific users.

The World Wide Web

Commercial Internet services and applications became popular in the 1980s, but users found it hard to access information because of poor computer interfaces. That changed in 1989, when a physicist named Tim Berners-Lee wrote a proposal in March 1989 for a “web of nodes,” “a large hypertext database with typed links,” that could be viewed by “browsers” on a network, but it generated little interest. Berners-Lee’s boss encouraged him to begin implementing his system on a newly acquired NeXT workstation (NeXT, which was founded by Steve Jobs, merged with Apple in 1997). Berners-Lee’s system was eventually dubbed the World Wide Web and was released in 1992. The World Wide Web made it much easier to access and use the Internet, and the number of Web sites gradually increased, then skyrocketed. In December 1991, there were 10 Web sites on the Internet. This number increased to 204 in September 1993, to 19.8 million in August 2000, and to 101.4 million in November 2006, according to Hobbes Internet Timeline. In September 2020, there were more than 1.8 billion Web sites, according to InternetLiveStats.com.

Easier Browsing and Better Desktop Computers

In late 1992, Marc Andreesen and Eric Bina, two programmers at the National Center for Supercomputing Applications at the University of Illinois Urbana-Champaign, began working on Mosaic, the first mainstream

commercial browser. It combined database capabilities with a graphical user interface. The center released the browser in 1993. Mosaic was eventually revised to work with Windows and Mac computers and emerged as Netscape. While the Internet and the Web were evolving, so were desktop computers. Computers were being used for word processing, databases, and spreadsheets. Laptop computers were introduced. Most historians consider the first true laptop computer to be the Osborne 1. Produced in 1981, it weighed 24 pounds and cost $1,795. The Osborne 1 came with a five-inch screen, modem port, two 5 1/4-inch floppy drives, a large collection of bundled software programs, and a battery pack. The computer industry was growing and people were seeing the huge potential. During this period, many tech companies—including Dell, Compaq, and Microsoft—emerged as major players.

Development of E-Commerce

The World Wide Web grew rapidly from the mid-1990s onward, and companies began to view it as a means to reach customers and make money. Amazon.com, the world's largest online retailer today (by revenue), went online in 1995, and many other companies (both "brick and mortar" and Internet-only) launched e-commerce sites. E-commerce plays a major role in the U.S. economy, and sales are only expected to increase as more companies use the Internet to well products and services. Total U.S. e-commerce sales reached $514.8 billion in 2018, according to eMarketer, up from $449.8 billion in 2017. Most noteworthy is the rapid increase of e-commerce transactions on mobile devices. In 2017, 58.9 percent of all retail e-commerce was generated via mobile devices, according to Statista.com. By 2021, this percentage is expected to grow to 72.9 percent.

Dot-Com Crash

Interest in the Internet was white hot in the late 1990s. In 1997, Six Degrees, the first social networking site, launched. Blogs became extremely popular. And in 1998, the Google search engine launched and the e-commerce site PayPal was founded. In 1999, Napster, one of the first peer-to-peer file-sharing sites in the United States, began operation. Internet

shopping became popular, and the term “e-commerce” was coined to describe this trend. Many Internet-based companies, known as dot-coms, were founded during this time.

And then the bottom dropped out. Tech stock speculation by the public, the availability of venture capital for tech start-ups, and other factors contributed to unrealistic stock price growth for many tech companies, which created a tech stock bubble that burst in 2000. Stock prices dropped dramatically. Nearly 500 tech companies went bankrupt—causing many people to lose their jobs. Other companies watched their stock prices plummet but managed to hang on until better times. By 2005, the tech industry began to bounce back, but many wonder if another dot-com crash is in our future.

The Rise of Social Media

After the dot-come bubble burst in 2000, the surviving Internet companies and those wishing to launch new dot-coms began to think about ways to improve the World Wide Web and better interact with users. Companies began asking for feedback about their products and services from customers and organizations began encouraging site visitors to interact with others who shared their interests. Technological developments such as improved browsers, the increasing use of broadband technology (which made the Internet faster), and the use of Flash application platforms (which improved the look and usability of Web sites) also changed the World Wide Web. These trends, according to Terry Flew, author of *New Media*, prompted a “move from personal Web sites to blogs and blog site aggregation, from publishing to participation, from Web content as the outcome of large up-front investment to an ongoing and interactive process, and from content management systems to links based on tagging.”

Although some forms of social media (such as virtual game worlds, massively multiplayer online role-playing games, blogs, and basic social networking sites) had been around for a while, the 2000s were the golden era for social media sites. Many sites launched during this time, including Wikipedia (2001), MySpace (2003), Flickr (2004), YouTube (2005), Facebook (2006), Twitter (2006), Tumblr (2007), Pinterest (2010), and

Instagram (2010). Today, Facebook is the largest social-networking site; it had 2.6 billion monthly active users as of July 2020.

The COVID-19 Pandemic and Its Aftermath

In late 2019, the coronavirus COVID-19 was detected in China and quickly spread to more than 210 countries, causing tens of millions of infections, hundreds of thousands of deaths, and massive business closures and job losses. In the short-term, the COVID-19 pandemic negatively affected the health of individuals; employment opportunities at businesses, nonprofits, and government agencies; and daily life and the job search process. It also had a major effect on the IT industry. Information technology job postings were down 36 percent in July 2020 as compared to July 2019, according to industry sources. There were far fewer job listings for data scientists and IT managers than in 2019, according to Indeed.com. “These roles are seen as more of an investment, and companies are being a lot more conservative than they would have been pre-coronavirus,” AnnElizabeth Konkel, an economist at the Indeed Hiring Lab, told CNBC, in an August 2020 article about IT hiring trends during the pandemic. “That’s the difference between those categories and IT help desk jobs, for example. Making sure employees have the hardware they need—that’s what firms are seeing as hyper-critical.” On the other hand, the outlook for IT businesses that specialized in e-commerce or provided services to e-commerce firms, was much better. There was also demand for social media professionals as more people stayed at home and used social media. Information technology companies such as Slack that developed chat and collaboration software experienced high demand for their products during the pandemic.

The job search process also changed during the pandemic. A survey of senior managers in the United States by the staffing firm Robert Half found that the top three hiring changes made by companies due to COVID-19 were more interviews and employee onboarding conducted remotely, a shortening of the hiring process, and more fully remote jobs being advertised.

It is hard to predict the long-term effects that the pandemic will have on the IT industry, but the research and advisory firm Gartner, Inc. has identified

the following trends:

- Thirty-two percent of organizations it surveyed planned to replace full-time employees with contingent workers in order to cut costs.
- Forty-eight percent of employees it surveyed will likely work remotely at least some of the time after the pandemic as compared to 30 percent before the pandemic.
- A Gartner analysis found that 16 percent of employers were “using technologies more frequently to monitor their employees through methods such as virtual clocking in and out, tracking work computer usage, and monitoring employee e-mails or internal communications/chat. While some companies track productivity, others monitor employee engagement and well-being to better understand employee experience.”

State of the Industry

Structure

The IT industry can be organized by type of employer (e.g., IT firms, companies with IT departments, etc.) and within the IT tech company category, by type of product or service provided (e.g., software vs. hardware). The following sections provide an overview of these areas:

Type of Employers

Tech Companies

There are 525,500 tech business establishments in the United States, according to CompTIA AITA, an industry association. These companies range from huge market leaders to small start-ups. In addition, there are thousands of small-to medium-sized companies that create specialized products, such as software to be used specifically to run corporate human resource departments. Some IT companies offer products and services in a variety of areas, muddling the distinctions between market segments. For example, Microsoft offers software, hardware, and consulting services. Major market segments and leading companies include:

- computer services (Google, IBM, Facebook)
- computer storage (Western Digital, NetApp)
- hardware (Apple, HP Inc., Dell)
- Internet and catalog retail (Amazon.com, eBay, Netflix)
- niche markets (cloud computing, data analytics, computer and Internet security, virtual reality, blockchain technology)
- semiconductors (Intel, Qualcomm, Texas Instruments)
- software & programming (Microsoft, Oracle, Adobe Systems)
- telecommunications Services/Internet Service Providers [Verizon Communications, AT&T, CenturyLink (Lumen Technologies)]

Software startup firms make up a large share of IT companies. The software industry is unique within the business world in that very little overhead

(equipment, office space, or personnel) is needed to start a software business. When an individual or group of individuals comes up with a good idea for new software and can convince financial backers to invest in their idea, a start-up is born. Many start-ups have tried to make a name for themselves with innovative and creative software applications. Often, these companies are so small and have such limited resources that they operate out of garages or basements. Industry leaders, such as Microsoft, Apple, and Google, all came from such humble beginnings. However, many start-ups never make it and go bankrupt. It is a good idea for individuals interested in working in software to be flexible and keep their technical knowledge up to date. In this way, if a company folds, programmers and designers can more easily find other employment.

Some large IT firms have consulting arms that provide IT advice to other companies, government agencies, and nonprofits. Major corporate-sponsored IT entities include IBM Global Business Services, Oracle Consulting, Cisco Consulting Services, SAP Advisory Services, and Microsoft Consulting Services. Other IT consulting firms have been launched by management consulting firms such as Deloitte, McKinsey & Company, Capgemini, Booz Allen Hamilton, and The Boston Consulting Group. There are also IT-focused research and advisory firms such as Gartner, Inc. and International Data Corporation. Other IT firms provide consulting services in niche areas such as data security, cloud computing, and data analytics, or in particular industries such as health care, energy, or retail.

Non-Tech Companies

Large corporations in other industries are also major employers of IT professionals, who maintain their information systems (IS) or IT departments and provide a variety of other services. All major companies, such as banks, insurance companies, consumer products firms, insurance firms, and media companies, have IS or IT departments or hire contractors to handle IT-related tasks.

Government Agencies

Agencies at the local, state, and national levels employ IT professionals to do the same type of tasks they do at IT firms and major companies—such as installing system upgrades, troubleshooting balky hardware, designing software, and ensuring systems and data are safe from hackers. Major federal government employers of IT professionals include the U.S. Departments of Defense, Health and Human Services, Treasury, and Justice; the National Aeronautics and Space Administration; and the Social Security Administration. A good way to get a handle on 490 federal agencies and sub-agencies is to check out the Partnership for Public Service's Best Places to Work in the Federal Government rankings at http://bestplacestowork.org.

Additional Employers

Some IT professionals work as salaried professionals or contract workers at nonprofit organizations (e.g., charities, private colleges and universities, etc.). Others transition from hands-on work in the field to become college IT professors.

Snapshot of the Industry Today

The global information and communications technology market reached an estimated $4.6 trillion in 2022, according to International Data Corporation, a market research, analysis, and advisory firm. The majority of IT spending is made by businesses and enterprises.

The U.S. IT market is the largest and most sophisticated in the world, earning an estimated $1.7 trillion in revenue in 2020, according to CompTIA. Approximately 55 percent of all information technology research and development is conducted in the United States, according to SelectUSA. Hardware, software, and services comprise 66 percent of industry expenditures, with telecommunication services making up the remaining percentage. The IT industry is one of the larger industries in the U.S. economy. According to the U.S. Bureau of Economic Analysis, the gross output of the technology industry was $1.6 trillion, representing 9.2 percent of the national economy. This output exceeded the individual outputs of the legal services, airline, construction, automotive, and hospitality industries. Approximately one in three U.S. IT companies (predominantly large and mid-size enterprises) conduct business internationally.

Approximately 12.1 million workers were employed in technical and nontechnical positions at IT firms and at companies, nonprofits, and government agencies that had IT departments in 2019, according to CompTIA, an industry association. This number also included self-employed IT workers who worked full time. At startups, nearly all employees are programmers, software engineers, and other technical workers. As a firm grows, marketing and sales staff are hired, lowering the percentage of technical workers. The 85/15 (technical/nontechnical) worker ratio is most common at large, established companies with a big market share. Non-IT sectors that hire a large number of technical and knowledge workers include information, finance and insurance, manufacturing, government, and management consulting.

Information technology professionals are employed throughout the U.S. and the world. In the United States, CompTIA reports that the highest number of IT workers are employed in the following states:

1. California: 1,866,951
2. Texas: 1,025,106
3. New York: 679,083
4. Florida: 585.296
5. Virginia: 446,507
6. Pennsylvania: 445,168
7. Illinois: 441,205
8. Massachusetts: 440,793
9. Michigan: 412,324
10. Ohio: 401,066

In 2019, CompTIA reports that the following states had the fastest IT job growth: California, Texas, Florida, New York, North Carolina, Washington, Massachusetts, Michigan, Colorado, and Georgia.

The *Forbes* Global 2000 is an annual ranking of the top 2000 public companies in the world in a range of categories. *Forbes* ranks the companies using a combination of four metrics: sales, profit, assets, and market value. In 2017, *Forbes* ranked the following U.S. companies based on IT industry specialty:

Computer Services:

- Alphabet (#24)
- IBM (#43)
- Facebook (#119)
- Cognizant Technology (#537)
- Yahoo (#898)
- Equinix (#1439)
- SYNNEX (#1790)
- F5 Networks (#1979)
- Akamai Technologies (#1998)

Computer Storage Firms:

- Western Digital (#757)
- NetApp (#1615)

Hardware:

- Apple (#9)
- Hewlett-Packard Enterprise (#171)
- HP (#271)
- Dell Technologies (#608)

Internet and Catalog Retail:

- Amazon.com (#83)
- eBay (#407)
- Liberty Interactive (#733)
- Netflix (#996)

Semiconductors:

- Intel (#54)
- Qualcomm (#170)
- Texas Instruments (#387)
- Micron Technology (#482)
- Applied Materials (#499)
- NVIDIA (#726)
- Lam Research (#871)
- Analog Devices (#1067)
- Skyworks Solutions Inc. (#1171)
- KLA-Tencor (#1246)
- Xilinx (#1371)
- Maxim Integrated Products (#1504)
- Microchip Technology (#1904)
- Advanced Micro Devices (#1955)

Software and Programming:

- Microsoft (#19)
- Oracle (#70)

- VMware (#645)
- Adobe Systems (#701)
- Symantec (#857)
- Fiserv (#972)
- Salesforce.com (#929)
- Intuit (#1042)
- CDW (#1155)
- CA (#1227)
- Citrix Systems (#1461)
- Snap (#1694)
- Autodesk (#1809)
- VeriSign (#1811)
- Workday (#1881)
- Amdocs (#1907)
- Red Hat (#1935)
- ServiceNow (#1967)

Telecommunications Services:

- AT&T (#11)
- Verizon Communications (#18)
- CenturyLink (#548)
- Level 3 Communications (#685)
- Crown Castle International (#1052)
- Liberty Broadband (#1207)
- Frontier Communications (#1357)
- SBA Communications (#1954)

The top trade and professional associations in the information technology industry include:

- The Academy of Interactive Arts & Sciences (http://www.interactive.org) promotes and advances the worldwide interactive entertainment community. It offers individual membership and also has corporate members such as Electronic Arts, Nintendo, Epic Games, Activision Blizzard, Microsoft Game Studios, Sony Computer Entertainment America LLC, Ubisoft, and Warner Bros. Interactive Entertainment.

- The American Society for Information Science and Technology (http://www.asist.org) is a major organization for information science and technology developers, practitioners, students, researchers, and in 50 countries.
- The Association for Computing Machinery (https://www.acm.org) has nearly 100,000 members from industry, academia, and government institutions around the world. It has more than 35 special interest groups (including computer graphics, human interfaces, artificial intelligence, data mining, mobile communications, computer education, software engineering, and programming language), publishes more than 50 journals, and sponsors more than 170 conferences. At its Web site, the association offers information on education, internships, careers, student membership, and *XRDS*, its student magazine.
- The Association for the Advancement of Artificial Intelligence (https://www.aaai.org) was founded in 1979 to advance the scientific understanding and use of artificial intelligence (AI). It publishes *AI Magazine*, offers a job bank at its Web site, and hosts conferences and other networking opportunities.
- CompTIA (http://www.comptia.org) is a membership organization for IT professionals and vendors. It provides continuing education classes and webinars, certification, and professional development conferences.
- The Digital Media Association (https://dima.org) bills itself as the "ambassador for the digital media industry: webcasters, online media, digital services, and technology innovators." Many top companies—such as Amazon, Apple, Google, Pandora, and YouTube—are members.
- The Entertainment Software Association (http://www.theesa.com) represents the professional interests of more than 35 companies that create computer and video games for video game consoles, personal computers, and the Internet.
- The IEEE Computer Society (http://www.computer.org) is one of the world's leading membership organizations dedicated to computer science and technology. It has more than 50,000 members. The society sponsors more than 200 technical conferences and events each year, publishes dozens of scholarly journals and magazines, has more than 300 local and regional chapters, and has more than 40 technical

communities. It also provides educational and career information, a certification program, and continuing education opportunities.

- The Software & Information Industry Association (http://www.siia.net) is the main trade association for the software and digital-content industries.
- The Technology Services Industry Association is the main professional association of the technology services industry. According to its Web site, its “members range from growing companies to some of the world’s largest enterprise companies, including 80 percent of Fortune 100 technology organizations.” It also has about 30,000 service practitioners as members.

Current Trends and Issues

The IT industry is constantly changing. Technological advances, changing consumer and business preferences, and other industry developments fuel the emergence of new products, new career paths, and new employment hot spots. For example, blockchain technology (a distributed ledger database that maintains a continuously-growing list of records that cannot be altered) may be the biggest IT disruptor since the emergence of the Internet. The growth of mobile computing has also changed the way content is prepared and viewed. Here are some of the major trends in the industry:

Emerging Occupations

The one constant of technology and tech careers is change. Given the speed of technological advancements, some positions may even completely transform or disappear in a matter of just a few years. Do you remember when the career of computer data entry operator was a hot job? That day is long gone. The key to remaining abreast of trends in the tech industry is to stay one step ahead of the game. Here are some emerging occupations to keep your eyes on:

- *Artificial intelligence engineers* are computer engineers who have specialized knowledge of artificial intelligence, machine learning, deep learning, computer vision, and related areas.
- *Blockchain developers* design and create the software for distributed ledger databases.
- *Chief Internet of Things officers* serve as the bridge between research and development, design, and production departments to create everyday objects with sensors that allow them to connect to the Internet.
- *Chief marketing technologists* are executive-level IT managers with the same skills, but more experience.
- *Chief mobile officers* supervise all things mobile, including apps, voice/data communications, and computing services.

- *Cloud computing architects* design and implement cloud computing systems.
- *Data scientists* help businesses and other organizations gather, analyze, and utilize vast amounts of information that are collected on the Internet, through wearable technologies, and other technologies.
- *Enterprise resource planning (ERP) project managers* oversee ERP software that allows an organization to manage and automate many back office functions related to technology, human resources, and services.
- *Marketing technologists* possess expertise in both marketing and information technology.
- *Virtual/augmented/mixed reality hardware and software engineers* design and develop these technologies for use in the gaming, health care, training, law enforcement, and other industries.

Internet and Data Security

Information security remains a hot topic as the number and sophistication of cyberattacks increases. In recent years, high-profile hacks on Sony Pictures, Target, Equifax, and Uber, and continuing cyberattacks on U.S. government agencies (including the National Security Agency) from hackers, terrorists, and state-level players have prompted industry and government officials to get serious about the cyberattack threat. CyberSeek.com—a project of CompTIA, Burning Glass, and the National Initiative for Cybersecurity Education—reports that demand is especially high for cyber security engineers, cyber security analysts, network engineers/architects, cyber security managers/administrators, software developers/engineers, systems engineers, systems administrators, vulnerability analysts/penetration testers, and IT auditors. But despite hot demand for tech security workers, nearly 508,000 cybersecurity jobs were unfilled in September 2020, according to CyberSeek.org.

This shortfall of cybersecurity workers is expected to only worsen. Cybersecurity Ventures, a leading global cyber economy research firm and publisher, predicts that by 2021 there will be a worldwide shortage of 3.5 million global cybersecurity workers. A related trend is the fast rise in salaries for cybersecurity workers due to demand. Data security analysts

earned salaries that ranged from $112,500 to $190,000 in 2020, according to Robert Half Technology.

Wearable Technology

Wearable technologies are software applications that are worn (watches, glasses, etc.) or embedded in clothing or in other objects. They are often connected wirelessly to the Internet. Wearable technologies gather and analyze data to assist the user in his or her daily life. They are also used in the workplace (e.g., to track employee performance; as training agents, as a means to improve customer service and improve efficiency in retail settings, and expedite production by creating hands-free guidance tools; etc.). Pricewaterhousecoopers reports that its data "shows that people are remarkably unconcerned about the net impact wearable technology could have on their job security or autonomy," although other studies show that consumers have major concerns regarding the privacy and security of their personal information gathered through this technology. Wearables will also be a major change agent in the Big Data, health care, advertising, and information industries. "The growing popularity of wearable computing devices…could drive IT job creation," predicts Robert Half Technology. "Expertise will be needed for the development of new devices and related applications, as well as to support the adoption of wearable technology in the workplace." It looks like wearables are here to stay. According to Gartner, Inc., worldwide end-user spending on wearable devices will reach nearly $63 billion in 2021, up from $32.4 billion in 2018.

Open Source vs. Microsoft

People entering IT discover that there are two general computer paths to follow. In a nutshell, there are software applications, systems, and database programs that work on computers using Microsoft Windows, and then there is "open source" software. Open source programs are free software that any user can modify and redistribute. Open source software and Microsoft software look different, act differently, and are operated very differently from each other. IT people must generally learn at least a portion of both.

When starting out, it tends to be easiest to choose one path from which to learn the basics: however, the popularity of both tends to fluctuate.

Microsoft products dominate the software market; about 90 percent of all home and business computers use various versions of the Microsoft Windows operating system. An overwhelming majority of computers are sold with Microsoft products already installed. However, open source resources have been spreading in business because they do not cost anything; they have a reputation for speed, reliability, and improved overall performance; and they give users a great deal of power to tailor the products to their own needs. Google, Adobe, Twitter, Facebook, IBM, Intel, LinkedIn, Microsoft, Samsung, and Netflix are just a few of the companies that use open source products—for the aforementioned reasons, but also as a strategy to attract and retain top development talent. Some of the most popular IT areas in which open source resources are used include cloud computing, content management, mobile, security, collaboration, network management, and social media. Look for open source technology to be increasingly embraced in the next several years.

Emerging Tech Hot Spots

When tech companies and startups are mentioned, one typically thinks of Silicon Valley in California and Seattle, Washington. That hasn’t changed, but recent surveys and studies have revealed some new up-and-coming cities for tech jobs. Many of these places aren’t as sexy and hip as Silicon Valley and Seattle (and other current tech hubs such as Boston and New York), but they offer good pay, a lower cost of living, and a good quality of life. Here is a recent list from Dice.com:

- Columbus, Ohio
- Louis, Missouri
- Atlanta, Georgia
- Denver, Colorado
- Dallas-Ft. Worth, Texas
- San Diego, California

One caveat: demand for specific careers varies by city, so you'll have to dig deep to see what city is the best match for your professional background.

Federal Government Struggling to Attract Young IT Workers

Although there is strong need for IT workers at federal agencies, the federal government is having trouble attracting young workers. In 2017, the number of federal IT workers age 60 and older was more than quadruple the number of specialists under the age of 30, according to a Nextgov.com analysis. This disparity suggests that there will be a federal IT worker shortage in the next decade as older workers retire or take jobs in the private sector. "Quite frankly, [the] government really can't afford to pay as much as the private sector in terms of salary and recruitment incentives," said Glorimar Maldonado, former chief recruitment officer at the Health and Human Services Department, in an interview about the trend at Nextgov.com. Young people also view federal agencies as stodgy, not innovative, and lacking career advancement opportunities and the employee perks that are available in the tech sector and at other private sector employers. Additionally, the federal hiring process is lengthy, which is sometimes unappealing to young people who want to move forward quickly with their careers post-graduation. Government agencies are attempting to counter this shortage by hosting tech-focused job fairs, educating young people about the diverse range of tech opportunities that are available with federal agencies, and trying to speed up the screening and hiring process for new workers. One lawmaker even proposed forming a Cyber National Guard, in which students studying cybersecurity would receive scholarships in exchange for working in government IT for a certain amount of time after they graduate.

Emerging Technology: Blockchain

Computerworld reports that blockchain technology "has the potential to eliminate huge amounts of record-keeping, save money, and disrupt IT in ways not seen since the Internet arrived." Blockchain is a distributed ledger database (similar to a relational database) that maintains a continuously-

growing list of records that cannot be altered. Each entry is time-stamped and linked to the previous entry. Each digital transaction or record is called a block in the chain of records, hence the blockchain moniker. Blockchain can either be an open system, where anyone can add information, or a controlled one, where only users with permission can access the system.

A key recent development in blockchain technology is the introduction of smart contracts, computer code that is stored on a blockchain that allows certain actions to be executed without human approval under specified circumstances. “Smart-contract technology can speed up business processes, reduce operational error, and improve cost efficiency,” according to *Blockchain Technology and Its Potential Impact on the Audit and Assurance Profession*, a report from the American Institute of Certified Public Accountants and other organizations.

Overall spending on blockchain technology will reach $15.9 billion in 2023, and have a five-year compound annual growth rate of 60.2 percent between 2018 and 2023, according to International Data Corporation.

Interest in blockchain technology has grown as a result of the recent emergence of cryptocurrency, a digital cash system that is increasingly being used as a substitute or complement to traditional currency. Cryptocurrency payments are not processed through a central banking system or trusted third party, but are sent from payer to payee. Bitcoin is the most-popular cryptocurrency. Blockchain is the technology that is used to facilitate cryptocurrency transactions.

In addition to cryptocurrency, blockchain technology is being used in many other fields. Here are some examples:

- Shipping: The international shipping industry generates massive amounts of paperwork (bills of lading, etc.). Maersk, the world’s largest container shipping operator, has announced that it will begin using a blockchain-based ledger to digitalize the supply chain.
- Finance: Accenture recently released a report that showed that the use of blockchain technology could reduce infrastructure costs at eight of the top 10 investment banks by about 30 percent, “translating to $8 billion to $12 billion in annual cost savings.” J.P. Morgan has created a

large blockchain payment network to more effectively reply to compliance issues and data-related inquiries.
- Jewelry Industry: Some of the world's largest jewelry businesses are planning to use a blockchain ledger to verify the provenance of jewelry products by allowing customers to track the item (such as a diamond) from a mine all the way to the jewelry store.

Growing interest in blockchain technology has created demand for IT workers with expertise in the technology. In 2018, the freelance employment Web site Upwork reported that blockchain development ranked first amongst the top 20 fastest-growing job skills. Blockchain developers earned median salaries of $130,000 in 2018, according to the data analytics firm Burning Glass Technologies.

Blockchain technology is rapidly being adopted by businesses. A 2020 survey of senior executives and practitioners in more than 10 countries and territories (Brazil, Canada, China, Germany, Ireland, Israel, Mexico, Singapore, South Africa, Switzerland, United Arab Emirates, United Kingdom, and United States) by Deloitte identified the following findings related to blockchain:

- Thirty-nine percent of respondents had already incorporated blockchain into production—up 16 percent from 2019.
- Fifty-five percent of responding organizations viewed blockchain as a "top strategic priority." This was an increase of 12 percent from 2018.
- Eighty-three percent of respondents said that their companies will lose competitive advantage if they don't adopt blockchain—up 6 percent from 2019.
- Although blockchain has become increasingly integrated into business operations, business leaders still have concerns about barriers to full adoption. Top barriers cited by senior executives and practitioners included implementation: replacing or adapting existing legacy system (which was cited by 36 percent of respondents); concerns over sensitivity of proprietary information (33 percent); and potential security threats (33 percent).

Hot Technologies: Artificial Intelligence and Machine Learning

Artificial intelligence and machine learning are two IT phrases that are often used interchangeably. Although they are linked, they are not the same. Artificial intelligence is an older and broader concept that machines can be programmed to perform functions and tasks in a "smart" manner that mimics human decision-making processes. Machine learning is a method of data analysis that incorporates artificial intelligence to help computers study data, identify patterns or other strategic goals, and make decisions with minimal or no intervention from humans. According to *Forbes,* "machine learning applications can read text and work out whether the person who wrote it is making a complaint or offering congratulations. They can also listen to a piece of music, decide whether it is likely to make someone happy or sad, and find other pieces of music to match the mood. In some cases, they can even compose their own music expressing the same themes, or which they know is likely to be appreciated by the admirers of the original piece." These are just a few examples of how artificial intelligence and machine learning are changing the way computers are used and how they interact with humans.

Several AI sub-specialties—including computer vision, deep learning, and natural language processing—are in strong demand. In computer vision, huge neural networks with many layers of processing units are used to teach machines how to view and interpret the world around them by using data collected by cameras and other methods. In deep learning, massive neural networks are used to teach computers to recognize speech, identify images, and even make predictions. Natural language processing aims to teach computers to understand, interpret, and manipulate spoken and written human language.

As a result of advances in both AI and machine learning, demand is growing quickly for IT professionals with this expertise. According to a recent edition of LinkedIn's annual *U.S. Emerging Jobs Report,* "jobs with the top growth potential are tech-focused, with demand coming from tech and non-tech companies alike. Machine learning engineers, data scientists,

and big data engineers rank among the top emerging job positions—with companies in a wide range of industries seeking those skills."

New Collar Job Programs

The American workforce has typically been divided into white collar jobs, those that require a college degree (typically a bachelor's degree or higher), and blue-collar jobs, those that require hands-on training, the completion of an apprenticeship, or the completion of a technical degree. With the high number of tech jobs that are going unfilled, IT company leaders are encouraging the federal government to create a new classification, new-collar jobs. These careers typically do not require a traditional education, but specialized skills and short-term training. IBM has been a leading proponent of the new-collar model. "New collar is all about skills and addressing the industry skills gap that we face in a world of fast-paced technology," explains IBM at its Web site. "A significant number of roles at IBM don't require a traditional education or career path. What matters most are the skills and experiences to perform a role." IBM is preparing new collar workers for jobs in cutting-edge areas such as cybersecurity, data science, artificial intelligence, and cognitive business, but also in manufacturing, laboratory support, and other fields. It offers an apprenticeship program that prepares those without a college degree for careers in software development, hardware design, system support, lab support, and other fields. You can learn more at https://www.ibm.com/us-en/employment/newcollar/apprenticeships. Additionally, IBM offers a paid Tech Re-Entry Program (https://www.ibm.com/employment/techreentry) for skilled technical professionals who took a break from the workforce but want to learn new skills without having to earn a degree. Another program, P–TECH (https://www.ibm.org/initiatives/p-tech), provides high school students from underserved backgrounds with the academic, technical, and professional skills and credentials they need to work in STEM careers. Participants earn both their high school diploma and a two-year associate degree in a STEM field.

As IT worker shortages continue, look for more companies to start new collar programs and seek other ways to train qualified workers outside the four-year and graduate-level college and university system.

Looking Ahead

Industry Outlook

Employment for many information technology (IT) professionals is expected to increase quickly through 2029. The U.S. Bureau of Labor Statistics projects annual employment growth of 11 percent for computer and IT careers. Here's a breakdown of expected growth and available new jobs through 2029 for some popular IT careers:

- Information Security Analysts: +31 percent, +40,900 jobs
- Software Developers: +22 percent, +316,000 jobs
- Computer and Information Research Scientists: +15 percent, +5,000 jobs
- Database Administrators: +10 percent, +12,800 jobs
- Web Developers: +8 percent, +14,000 jobs
- Computer Support Specialists: +8 percent, +67,300 jobs
- Computer Systems Analysts: +7 percent, +46,600 jobs
- Computer Network Architects: +5 percent, +8,000 jobs
- Network and Computer Systems Administrators: +4 percent, +16,000 jobs

Driving this growth are several factors: increased adoption and utilization of technology by business and individuals; expanding use of cloud computing, artificial intelligence, and virtual/augmented/mixed reality; concerns about computer security; growing use of mobile computing devices, and the increasing role of information technology in health care, financial services, and other industries.

The International Data Corporation, (IDC) an American market research, analysis, and advisory firm, predicts steadily growing demand for software, citing increasing interest in collaborative tools, green information technology, e-commerce, and mobile applications. Consumers in the U.S. spent $35.4 billion on video game content in 2019, according to the Entertainment Software Association. Total U.S. e-commerce sales reached $514.8 billion in 2018, according to eMarketer, up from $449.8 billion in 2017. Falling prices of computer hardware and software should continue to

encourage more people to use technology and more businesses to expand computerized operations and integrate new technologies. To maintain a competitive edge and operate more cost-effectively, firms will continue to demand computer professionals who are knowledgeable about the latest technologies and can apply them to the needs of businesses.

The expanding integration of Internet technologies, especially for wireless and handheld devices, has resulted in a rising demand for a variety of skilled professionals who can develop and support Internet, intranet, and World Wide Web applications. Growth in these areas is expected to create strong demand for computer scientists, engineers, and systems analysts who are knowledgeable about networks, data, and communications security.

In its *2021 Salary Guide for Technology Professionals*, Robert Half Technology identified the following careers as "critical technology roles" (in which job demand was very strong):

- artificial intelligence/machine learning specialists
- business intelligence analysts
- cloud architects
- cybersecurity and data privacy experts
- data analytics and reporting professionals
- data scientists
- developers (database, full-stack, web, software, mobile)
- engineers (cloud, data, DevOps, network security, software)
- help desk and user support professionals
- information technology administrators (database, network, systems).

Robert Half Technology also predicts that, in addition to growth in the technology sector, demand for IT workers will be especially strong in the following industries:

- health care: due to a need to invest in telemedicine, as well as use artificial intelligence (AI), data analytics, cloud computing, augmented reality (AR), and mixed reality (MR) to modernize their operations, improve the bottom line, and provide better or more innovative care to patients

- financial services: which needs experts in AI, machine learning, blockchain, business development, and application programming interface development
- government agencies (at all levels): to upgrade outdated infrastructure, manage digital transformation efforts (including cloud migration), and "offer a more personalized experience to the citizens they serve"
- manufacturing and distribution: because of the need to modernize and automate production processes and the need to introduce and/or expand the use of advanced analytics, AI, robotics, AR, and the Internet of Things.

Cloud computing, which provides products and services as needed via the Internet, has caught on with many businesses and organizations. More than 90 percent of U.S. firms use some form of cloud computing, according to CompTIA, a nonprofit industry trade association. More than 60 percent of those companies reported that cloud components represent at least one-third of their overall information technology architecture. Use of cloud computing is expected to grow quickly in coming years. IDC reports that the worldwide public cloud services market reached $233.4 billion in 2019—up from $160 billion in 2018 and $45.7 billion in 2013. The market is projected to grow at a compound annual growth rate of 22.5 percent through 2022. Although this is anticipated to create an overall rise in demand for IT workers, it may also result in a shift as work previously done by internal IT departments is assigned to cloud vendors.

Computer security is also expected to drive future employment growth. In 2018, more than 2 million cyber incidents occurred, resulting in more than $45 billion in losses, according to the Internet Society's Online Trust Alliance. Employment of information security analysts is expected to grow by 31 percent from 2019 to 2029, according to the DOL. "Organizations across industries like finance, retail, and education are looking for skilled professionals to design and implement comprehensive information security that covers a wide range of business security priorities," advises Peninsula Press, a project of the Stanford Journalism Program. Security software such as antivirus programs, firewalls, and other malware detection systems will be in steady demand and require regular updating to keep pace with new types of cyberattacks.

Another strong sub sector is "Big Data." Today, our every keystroke, Facebook “like,” credit card purchase, and many of our offline activities are being collected and analyzed by data analytics firms to help companies sell more products and services to customers. Businesses are using data analytics to assess employee productivity, and government agencies are using analytics to study crime patterns, predict threats of terrorism, and improve the delivery of services to citizens. The *Washington Post* reports that “it will take an estimated two million new computer scientists, mathematicians, engineers, and statisticians to sort through the cacophony of data.”

The demand for data analytics professionals is prompting renewed interest in the study of statistics. The number of degrees awarded in statistics at the undergraduate level grew by 42 percent from 2014–15 to 2017–18, according to the National Center for Education Statistics. Another promising aspect of this trend is that it will result in more women entering the IT industry. Nearly 44 percent of degrees in statistics were awarded to women in 2017–18—a percentage that is much higher than the average for other STEM-related majors.

Employment opportunities in the computer industry are numerous and varied. Flexibility is key because as the industry shifts into new, unexplored areas, computer professionals have to shift as well. In addition, many computer professionals use certain jobs as springboards to other higher-level jobs. For example, few professionals want to work in technical support long term, but many start there to get a foot in the company's door in order to be first in line for any internal positions that open up.

Advanced software capable of writing basic code has eliminated some jobs, and other programming jobs are at risk of being outsourced to other countries. Three traits are essential to aspiring computer professionals: determination to keep up with the latest technology, flexibility, and formal education. Of course, a solid understanding of computer basics is required as well. However, the technology of today will be obsolete in months, if not weeks, and only those individuals who strive to be on the cutting edge will have long-term growth potential.

Know the Field

Job Searching in This Industry

Approximately 12.1 million workers were employed in technical and nontechnical positions at IT firms and at companies, nonprofits, and government agencies that had IT departments in 2019, according to CompTIA, an industry association. This number also included self-employed IT workers who worked full time.

There are opportunities with major tech companies such as Google and Apple, with small-and mid-sized firms (most of which are off the general public's radar), in the IT departments of companies of all sizes (including Prudential Financial, Owens Corning, Genentech), and with nonprofits and government agencies. There are many job opportunities, but applicants must be willing to move to pursue good job leads, work nontraditional schedules, and otherwise adjust their expectations based on the position being offered.

Job applicants should also be aware that strong competition exists for jobs at hot IT companies. For example, Twitter received an average of 230 applications per open job in 2015, according to *Fortune.* The odds of getting hired weren't much better at Google, which received 200 applications per available job. As a result, you must use every resource available to find job openings (even if you're targeting jobs at "less cool" employers such as small companies or government agencies). Some popular job-search resources include company Web sites, social-media sites (such as LinkedIn), professional associations, career fairs, networking, recruiters, university recruitment programs, and information interviewing.

Company Web Sites

A great strategy is to go right to the source: the Web sites of the company, nonprofit, or government agency where you want to work. These sites often provide information on departments, career paths, the work environment, as well as job listings. Some even offer an overview of the organization's

hiring process; tips on cover letter, resume, and interview formats; worker profiles; and information on college recruiting and career fairs. Here are a few examples of company job-search resources:

- Google offers advice on preparing a curriculum vitae/resume; information on its interview process, departments, internships, and career paths; and details about its 85 offices in approximately 40 countries at https://careers.google.com/how-we-hire.
- Facebook offers a summary of its departments (software engineering, data and analytics, IT and security, etc.); articles such as Acing Your Software Engineering Internship Interview at Facebook; and job openings by location at http://www.facebook.com/careers/?ref=pf. You can also stay connected to Facebook, by visiting its actual Facebook page, https://www.facebook.com/facebookcareers.
- Microsoft offers information on career paths and internships, career webinars, resume preparation and interviewing advice, and much more at https://careers.microsoft.com/us/en/faq and https://careers.microsoft.com/us/en/interviewtips.
- IBM offers job listings and information on college recruiting, internships, resumes, the hiring process, and career paths at https://www.ibm.com/us-en/employment.
- Intel offers an overview of its departments (e.g., IT, engineering, software, etc.), job listings, information on the job application process (including interviewing tips and videos discussing the process), and other resources at https://jobs.intel.com/page/show/hiring-process. Also check out its blog, https://blogs.intel.com/jobs.
- Texas Instruments provides information on career paths; resumes; interview formats, questions, and preparation; and more at https://careers.ti.com/hiring-interview-process.

Information at Web sites changes frequently, so be sure to check with your target employers for the latest resources.

Job-Search Resources

Many specialized Web sites and publications provide information about the industry and specific companies, job leads, blogs, and salaries. At some of

these sites, you can even apply for jobs.

Here's a sampling of popular industry Web sites and publications:

- *http://www.computerworld.com*. *Computerworld* is a major industry publication. Use it to learn about hot jobs and top employers, industry trends, salaries, and other topics that will help you land and keep a job. Participate in its blogs to raise your industry profile and make networking contacts. Check out its various articles on interviewing, networking, and resume writing, as well as articles about industry trends.
- *https://www.creativeheads.net*. This Web site offers job listings for the video game, animation, visual effects, and software/technology industries.
- *http://www.dice.com*. This is a key site for tech job-hunters, with more than 53,000 job listings. Upload your resume for review by potential employers, and search for jobs by skill/job title, company, location, and employment type. Sign up for a free account to get e-mail alerts about job openings and follow industry developments. You can also read dozens of articles about the job search, such as "5 Job Hunting Tips for Computer Science Grads," "Networking: It's About Quality, Not Quantity," and "5 Big Interview Mistakes to Avoid."
- *https://jobs.computer.org*. This is the IEEE Computer Society's job board. You can post your resume, search available jobs, and read and participate in industry blogs.
- *http://jobs.acm.org*. This site is sponsored by the Association for Computing Machinery, the world's largest computing society. You can post your resume, access job listings, sign up for e-mail alerts about hot jobs, and read free career articles about landing a job. You should also check out *CareerNews* (https://www.acm.org/articles/careernews), a twice-monthly publication that provides a list of articles about career- and job search topics that are published by other providers.
- *http://webprofessionals.org/jobs*. Use this site to search for web design, development, security, search-marketing, and engineering jobs. You can also post your resume, read a blog, and learn more about education and certification.

If you want to work at a start-up, look for job listings on sites such as:

- http://www.startupers.com
- https://angel.co/jobs
- https://venturefizz.com

Here are some general job sites that also provide IT job listings:

- http://www.careerbuilder.com
- http://www.indeed.com
- http://www.monster.com

Professional Associations

Professional associations can provide many useful resources during your job hunt. Some offer employment listings at their sites. These include:

- Association for Computing Machinery: http://jobs.acm.org
- Information Systems Security Association: https://issa-jobs.careerwebsite.com/jobs
- IEEE Computer Society: https://jobs.computer.org
- TDWI: https://jobs.tdwi.org
- Women in Technology: https://womenintechnology-jobs.careerwebsite.com

Other associations provide networking opportunities, salary surveys, continuing education classes, certification, publications, membership, and additional resources. Many have a presence on social media. The Association for Computing Machinery offers membership options for college students and professionals, a free career content library, publications (such as *XRDS*, a magazine for students), continuing education classes and webinars, blogs, and job listings. It also has a presence on LinkedIn, YouTube, Twitter, Instagram, Flickr, and Facebook. Another useful organization is the Digital Analytics Association. It offers membership for college students and professionals, the Web Analyst Certification Program, continuing education programs, conferences, networking events, job listings

at its Web site, and other resources. It's also active on social media. Don't forget to also check out IT associations at the state and local levels.

University Recruitment Programs

Many large tech companies have well-developed relationships with colleges and universities. They work with colleges to provide internships, co-ops, fellowships, and other opportunities that seek to identify promising future employees and give them experience at the company. These are great ways to break into the industry. If you impress your supervisor during one of these programs, you might be considered for a future job. For example, Apple offers internships and co-ops for undergrads and grad students. Additionally, students at selected colleges can receive training to become qualified to work from their homes or dorms as Apple Support College Advisors. In this paid position, advisors use an Apple-provided iMac and headset to provide technical support to Apple customers. College students can also work as Apple Campus Leaders to represent the IT leader on campus. Visit https://www.apple.com/jobs/us/students.html for more information on Apple's programs for college students. Google (https://careers.google.com/students) also offers several great programs for college students. Visit the Web sites of other companies to learn about their programs.

Industry Conferences

Tech conferences offer an excellent combination of educational sessions, networking events, and opportunities to meet recruiters and learn about IT companies and the latest industry trends. Conferences are hosted by tech companies, industry associations, and colleges and universities with tech programs. Here are some major tech conferences.

- SXSW Conference: http://www.sxsw.com
- Apple Worldwide Developers Conference: https://developer.apple.com/wwdc
- Google I/O: https://events.google.com/io

- IEEE Computer Society Conferences & Events: https://www.ieee.org/content/ieee-org/en/conferences
- Association for Computing Machinery Conferences: http://www.acm.org/conferences

The COVID-19 pandemic forced some conferences to be converted to online-only events, while others were held in a limited in-person format during the pandemic. Contact conference sponsors for the latest information.

Researching Companies

There are 525,500 tech business establishments in the United States, according to CompTIA. Many, such as Apple and Intel, provide IT services and products, while others (such as Ford Motor Company and Wal-Mart) have IT departments or farm out their IT needs to private contractors. Nonprofits and government agencies also employ IT professionals. This adds up to a lot of opportunities, but how do you find employers that are the best fit for your education, skills, and personality? Career fairs, employer Web sites, information interviews, networking, “best company” lists, magazines and journals, industry databases (e.g., D&B Hoovers, Dun & Bradstreet, Factiva, and Orbis), and social networking sites are just a few of the ways you can learn more about potential employers.

Use Social Media

Social media sites are an easy way to get info on employers, including their application and interviewing processes, work environments, and typical salaries. This information either comes directly from the employer (at their LinkedIn, Twitter, or other sites) or through current and former employees of these organizations. Use the following social-media sites to learn more about employers:

- LinkedIn is the place to be if you want to learn about information technology careers and firms. In addition to creating your own profile, you should join IT groups, follow IT firms, and try to connect with IT recruiters and people already working at your target employers.
- At Twitter.com, you can create an account and begin tweeting to raise your industry profile. You can also follow IT companies, tech experts, and recruiters to get the latest IT news.
- MeetUp.com allows you to locate IT networking groups in your area.

Land Some Information Interviews

“Informational interviews are a great source for gathering information about an occupation or an industry in which you are currently interested,” advises the University of Virginia’s Center for Engineering Career Development. “An informational interview is an interview that you initiate—you ask the questions. The purpose is to obtain information, not to get a job.” Ask your career counselor or professor to help arrange information interviews with people in your desired field, or use LinkedIn or your network to identify potential candidates. Your goal is information, but who knows, maybe your meeting could result in an offer of an internship or even a job. Your questions can run the gamut—from asking about the interviewee’s company and others in the industry, to his or her job duties and work schedules, and how to break into the field. Ask the following questions during information interviews:

- What’s made your company successful? Who are its main competitors?
- What’s the work environment like at your company?
- Can you please describe a day in your life on the job?
- What type of travel does your job require?
- What are the most important personal and professional qualities for people in your career?
- Are you certified? How important is certification to career success in the tech industry? What are some of the most popular certifications?
- What do you like best and least about your job?
- What’s the best way to network in the tech industry?
- What’s the best way today for people to land jobs in the industry?
- What advice would you give to job seekers in terms of applying to and interviewing for jobs?
- What’s a typical job interview like in the tech industry?
- What is the future employment outlook for your career and the tech industry in general? How is the field changing?

Check Out Industry Best Lists

If you’re interested in an IT career, you’re obviously aware of industry leaders such as Apple, Microsoft, IBM, and Google. In addition to these companies, however there are many others that have been recognized for

being innovators, offering good pay and strong benefits, or being great places in which to work. Several magazines publish lists of best tech companies (both large and small). These lists are a great starting point to learn more about tech companies. Remember however, that "best company" lists often feature only a small number of companies. Plenty of excellent organizations don't make "industry best" lists. You can learn about them through networking, career fairs, social media, and other methods.

Here are a few magazines that publish lists of the best tech companies:

- *Computerworld* publishes an annual list of the "Best Places to Work in IT" at https://www.computerworld.com/article/3400380/best-places-to-work-in-it-2019.html.
- *Fast Company* publishes an annual ranking of the most innovative companies. In 2020, some of the most innovative data science, AR/VR, artificial intelligence, and social media companies were Strava, AutoDesk, Striver, Snap, Graphcore, Nvidia, Cameo, and Pinterest. Check out https://www.fastcompany.com/most-innovative-companies for the latest lists.
- *Forbes* publishes the "Global 2000: The World's Best Employers." Its 2019 list included the following tech firms: Alphabet, Microsoft, Red Hat, Apple, SAP, Cisco Systems, Amazon, IBM, Oracle, and Intuit. See https://www.forbes.com/lists/worlds-best-employers/#6c4dab5a1e0c. *Forbes* also publishes the "AI 50: America's Most Promising Artificial Intelligence Companies" (https://www.forbes.com/sites/alanohnsman/2020/07/03/ai-50-americas-most-promising-artificial-intelligence-companies/#5752844a5c99) and "The Just 100," which it defines as companies that are "doing right by America." Some of the tech companies that made the list include Microsoft, Nvidia, Apple, Intel, Salesforce, Alphabet, PayPal, and Cisco. Visit https://www.forbes.com/just-companies/#700ef1dc2bf0 to read the complete list.
- *Inc*. publishes a list of the fastest-growing private companies in America in various categories such as software, IT system development, IT management, and non-IT categories. Some of the software firms on the list include OneTrust, Lattice, Pendo, Algo,

Ocrolus, and ZeroBounce. Visit https://www.inc.com/inc5000/list/2017 for more information.

- *Fortune* and Great Place to Work publish a list of the best companies to work for at http://fortune.com/best-companies. *Fortune* also publishes a variety of industry best lists (such as the "100 Best Workplaces for Millennials" and "World's Most Admired Companies") at http://fortune.com/rankings.
- DiversityInc publishes "The DiversityInc Top 50 Companies for Diversity" and other lists at https://www.diversityinc.com/the-2020-top-50-diversityinc.

Many local publications in large cities publish lists of the best places to work, including:

- *The Atlanta Journal-Constitution:* http://www.topworkplaces.com/frontend.php/regional-list/map/ajc
- *Boston Business Journal*: https://www.bizjournals.com/boston/best-places-to-work
- *Boston Globe*: http://www.bostonglobe.com/business/specials/top-places-to-work
- *Chicago Tribune*: https://topworkplaces.com/publication/chicagotribune
- *Crain's New York Business:* https://www.bestplacestoworknyc.com/Winners
- *The Denver Post:* https://topworkplaces.com/publication/denverpost
- *Florida Trend:*http://bestcompaniesfl.com
- *Los Angeles Business Journal:* http://www.bestplacestoworkla.com
- *San Diego Business Journal:* https://bestplacestoworksd.com
- *Seattle Business:*https://www.seattlebusinessmag.com/seattle-event/100-best-companies-work-2020
- *StarTribune*(Minnesota): https://www.startribune.com/top-workplaces/510737631

Visit https://topworkplaces.com/explore-local-top-workplaces for best company lists in other cities.

Find Start-Ups

Apple, Google, Amazon, Hewlett Packard Enterprise, and almost any other popular tech firm you can name were once startups (fledgling businesses—which often focus on technology—that are initially funded by angel investors and venture capitalists). Landing a job at a start-up is an excellent way to obtain experience and possibly get your foot in the door at what could be a successful business. Check out the following Web sites to use to learn more about tech start-ups:

- https://www.forbes.com/entrepreneurs/#2db686633035
- https://www.crunchbase.com
- http://www.startupers.com
- https://angel.co/jobs

Many other magazines, such as *Inc. and Fortune*, publish articles about tech start-ups to watch. Visit their Web sites for the latest information.

Making Connections

Networking

“Networking sounds scary but it is one of the most effective career development tools that you can carry with you your entire professional life,” advises the Penn State Alumni Association. “Even if you are not a born networker, networking is an important skill that can easily be learned and refined throughout your career.” Networking really just boils down to talking with friends, family, acquaintances, and people you don’t even know in an attempt to build relationships, educate others about your educational background and skills, and learn about job leads. The goal is to collect information and make contacts—not to ask for a job or randomly pass out your resume. Of course, if someone asks you for your resume or even offers you a job during the process, that’s even better.

Most people network both in-person (at career fairs, job-search groups, industry conferences, internships, etc.) and online (on social media sites, message boards, and blogs, or via Twitter or e-mail).

One major piece of advice: start networking while you’re still in college. If you wait to start networking till after you graduate, you’ll have missed the chance to participate in internships and information interviews, talk to your professors about your career interests and potential employers, use the services of your college’s career services (some departments even offer seminars on the best networking strategies), attend career fairs, and otherwise connect with people. Continue to use the resources of your college’s career services office after graduation. Some offices may offer alumni mentoring programs, which connect new graduates to industry mentors.

Reach Out to Your Existing Networking Contacts

Begin by contacting your friends and family to see if anyone you know works in the IT industry or knows someone who does so. You should also touch base with:

- roommates/classmates from high school/college
- coaches
- teachers/professors
- fellow athletes
- fraternity/sorority members
- current and past employers
- neighbors/community members
- members of your religious community
- people you volunteer with
- members of social organizations you're involved in
- members of professional associations
- people who work in personnel departments or for placement or search agencies

Join Professional Associations

Professional organizations provide numerous networking opportunities. Many host conferences, continuing education classes, formal networking events, and other gatherings where members can get together and network. Most major IT associations have discussion boards on Facebook, LinkedIn, or other social media sites, on which members can meet and discuss industry trends, employers, and job leads. The IEEE Computer Society is a good example of an organization that provides a wealth of networking activities to its members. It offers membership in regional chapters, groups for college students, and special interest groups (e.g., cloud computing, computer security, etc.), as well as volunteer opportunities and professional development classes. The society also has a presence on LinkedIn, Facebook, Instagram, YouTube, and Twitter. Another professional association, the Information Architecture Institute, offers a professional peer-to-peer mentoring program to its members, in addition to networking opportunities at local chapter events.

Once you've logged some time as a member, consider taking on leadership positions with your organization. "Seeking out and accepting a leadership role in the association will help you learn to network more naturally," said Julian Wade, then CompTIA Executive Council chair emeritus, in an article about the importance of networking at the organization's blog. "It's also a

perfect opportunity to practice your leadership skills in a non-threatening environment, where an early mistake will not affect your job."

Volunteer

Volunteering is another effective networking tool. Some of the people you work with on volunteer projects can turn into networking connections—and potential job leads. At the IEEE Computer Society, for example, volunteers write articles for society publications and help organize and plan conferences and other events, among other duties. In the past, the Information Architecture Institute sought peer reviewers for library content, library curators, social media mavens, and a host of other tech professionals to volunteer to help revamp its Web site. Additionally, the institute has an ongoing need for volunteers to help out with regular events such as World IA Day, local summits, and cocktail hours. Be sure to also check out volunteer opportunities via school and alumni programs.

Volunteering with an association can help you get noticed by organization big-wigs, who are often key industry players. Volunteer experience can also help you stand out during the interview process. Tech companies such as Google and Apple like to hire people who have used technology to do great things in their communities. TECH CORPS (http://www.techcorps.org) is an example of a nonprofit organization where you can volunteer. The nonprofit educates elementary, middle school, and high school students about technology through camps, clubs, and workshops. Don’t forget to check out local organizations. For example, if you live in the Chicago area, you could volunteer with The Chicago Council on Science & Technology. If you live in or near Birmingham, Alabama, you can volunteer with TechBirmingham.

Here are a few Web sites that will help you explore volunteer opportunities.

- Idealist: http://www.idealist.org
- VolunteerMatch: http://www.volunteermatch.org
- UN Volunteers: http://www.onlinevolunteering.org
- SCORE: http://www.score.org/volunteer

- Corporation for National and Community Service: http://www.nationalservice.gov

Use Social Media

Fifty-two percent of graduating college seniors used social media in the job search (most commonly to network with potential employers) in 2017, according to a survey by the National Association of Colleges and Employers (NACE). The education organization reports that "the most common way that they did so was to research potential employers of interest via a platform's search bar, followed by posting a resume on a publicly accessible profile, and communicating with friends and/or family to discuss job openings and potential employers." LinkedIn is the most popular professional networking site in the United States. Nearly 60 percent viewed LinkedIn as "very useful" or "extremely useful" in their job search. At LinkedIn, you can network with your friends and family, IT recruiters, and people who are already working at your dream IT employers. You should also set up a profile, follow IT companies, and join interest groups (LinkedIn has thousands of interest groups for IT workers). By joining these groups, you can learn about IT companies, the job-search and interview process, industry trends, and other topics, and you can network with other members. Joining a group might even help you land a job. It's free to join LinkedIn—unless you want an upgraded membership that allows you to send more InMails (LinkedIn's version of e-mail) to potential networking contacts, see more profiles when you search, and view expanded profiles.

MeetUp.com allows you to connect with people in your area. Some of its groups include Windy City Tech Meetup (Chicago), NYC TechBreakfast, PitchCoach: Perfect Your Startup Pitch (San Francisco), and RMOUG Women in Technology (Denver).

MeetUp.com allows you to connect with people in your area. Some of its groups include Windy City Linux Users Group (Chicago), NYC TechBreakfast, Pitch Coach: Perfect Your Startup Pitch (San Francisco), and Rocky Mountain Oracle Users Group (Denver).

GitHub (https://github.com) is a collaborative community for software developers and engineers. It's free for individuals looking to share their own software development projects and collaborate with others; a small monthly fee is required for those who want to work on private projects.

Kaggle (https://www.kaggle.com) bills itself as the "world's largest community of data scientists…[who] compete with each other to solve complex data science problems, and the top competitors are invited to work on the most interesting and sensitive business problems from some of the world's biggest companies through Masters competitions." Kaggle is a great way to get noticed by other IT professionals and major IT companies. It also offers job listings and a discussion forum.

Spiceworks (https://community.spiceworks.com/how_to/41357-how-to-write-a-great-it-resume) is a combination news site, IT collaborative community, product review site, and organizer of local meetups for tech professionals.

Networking Advice

Here are a few tips to help you become a successful networker:

- Establish networking goals before you get started (e.g., obtaining information about a particular company, meeting with three IT recruiters at a career fair, or connecting on LinkedIn with two current employees of your target company).
- Focus on quality over quantity. A pile of business cards and company brochures collected at a career fair won't be of much help, but the two software engineers you spoke to at length can be a definite asset in your search for a software engineering position.
- Always be networking. You never know where or when you'll meet someone who can provide you with a job lead.
- Maintain your network by staying in regular touch with your contacts.
- Networking is a two-way street. Don't forget to help others who ask for job leads.
- Always be professional when networking. When attending networking events, be friendly, dress appropriately, listen closely to others, and

demonstrate good body language. When online, be polite, avoid slang, use proper grammar and spelling, and be respectful of other people's opinions and life experiences.

- Continue networking even if you have a job. Set a goal of meeting at least one new person a week. It's a good way to continue to expand your contacts, stay up to date on industry developments, and be prepared if you lose your job.

Cover Letters

Good cover letters immediately engage a hiring manager's interest and entice them to learn more about you, read your resume, and invite you for an interview. The debate continues about the necessity of cover letters and if hiring managers even read them, but unless directed not to do so, you should submit a cover letter along with your resume. The cover letter may be submitted as a hard copy via snail mail, but more likely these days, as a text in the body of an e-mail that also includes your resume or as a PDF attachment in an online submission. Regardless of how it's submitted, your cover letter should answer the following questions:

- Who am I?
- What are my qualifications?
- What can I do for this specific IT firm or department and in this specific position?
- What intangible skills and experience can I bring to the firm that other applicants lack?

Your cover letter should feature no more than three short paragraphs.

1. Paragraph #1 states who you are and what you'll bring to the firm. Concisely list the scope of your experience, the number of years you've worked in the field, the certifications you've earned, the school you attended (if it's a top-tier school) and your GPA (if it's impressive). This is also a good place to mention if you've been referred by another employee of the firm.
2. Paragraph #2 explains how you will solve the employer's problem. Provide one strong reason to convince the reader to move on to your resume. Link your skills and experience to the specifics of the job listing and the needs of the employer.
3. Paragraph #3 is a call to action in which you thank the hiring manager for his or her consideration and say that you'll be in contact to set up a time to discuss the job further. Get noticed by being confident and asking for a meeting.

Here are some additional tips on creating an effective cover letter:

- Show your passion. Stand out from the other job seekers by showing that you not only have the qualifications to do the job, but also are passionate about working at XYZ company. Praise one of its product lines or mention a positive industry development (e.g., a successful merger, an award it won, etc.) to show that you're in the know and really want to work at the company (Put this in paragraph #1.). Additionally, talk about one of your accomplishments (e.g., winning an award or saving your company money by developing a new database or type of software), and state how satisfying the accomplishment was and how you'd like to do the same at this new company.
- Create a customized cover letter for each job opportunity. Your chances of being asked to interview will increase if you skip the generic "one size fits all" cover letter and include keywords from the job advertisement, and match your skills, certifications, and educational background to those listed in the job announcement.
- Make it perfect. If you have superior experience and technical skills, one typo on your cover letter or resume may not doom your job chances in the IT industry, but why risk it? Strive to submit error-free application materials. Doing so tells the hiring manager that you're detail oriented and take the job-search process seriously.
- Don't forget to spotlight your soft skills. "It's not all about technology, even in the IT field," according to "How to Write Unbeatable Cover Letters," on Dice.com. "For IT cover letters, it is extremely important to incorporate your soft skills. An unbeatable IT cover letter explains how you have used both technical and soft skills to affect positive change."
- Never lie on your cover letter or resume. Hiring managers often perform background checks (especially for sensitive positions), and your lies will quickly be discovered and disqualify you from consideration.
- Avoid generic salutations. It's easy today to locate the names of hiring managers or recruiters on the Internet (company Web sites, LinkedIn, etc.). If you've exhausted every avenue to track down an actual person's name, it's okay to use gender nonspecific salutations such as "Dear Hiring Manager" or "To whom it may concern."

- Show your value. In the cover letter, don't just talk about what you can get out of the job, talk about what the employer will get from you!
- Don't rehash or repeat the contents of your resume in the cover letter. Avoid detailing job duties at past jobs, and instead, focus on your technical and soft skills, your passion for the job, and brief coverage of the key credentials (e.g., certification, knowledge of in-demand software, etc.) that will land you the job.
- When you've finished writing your cover letter, ask yourself the following questions: Does it quickly convey my qualifications? Does it show a bit of my personality and my enthusiasm for the job? Is it one page in length? Does it contain simple and direct language that tells the employer why they should hire me and why I would be a good fit at the company? If the answer is no for any of these questions, you need to go back to the drawing board.

Here are some Web sites that provide tips on creating an effective cover letter:

- How to Write a Great Cover Letter: https://www.cio.com/article/2877934/how-to-write-a-great-cover-letter.html
- Information Technology Cover Letter Examples: https://www.livecareer.com/cover-letter/examples/information-technology
- How to Start a Cover Letter: 31 Attention-Grabbing Examples: https://www.themuse.com/advice/31-attentiongrabbing-cover-letter-examples
- 7 Key Elements of a Successful Cover Letter: https://www.indeed.com/career-advice/resumes-cover-letters/parts-of-cover-letter
- Writing Cover Letters: https://writing.wisc.edu/handbook/assignments/coverletters
- IT Cover Letter: https://www.monster.com/career-advice/article/it-cover-letter-sample
- I Review Hundreds of Cover Letters—Here's What I Instantly Reject: https://www.fastcompany.com/3064221/i-review-hundreds-of-cover-letters-these-are-the-ones-i-instantly-rej

- CVs, Resumes & Cover Letters: https://career.ucsf.edu/phds/non-academic/cvs-resumes-cover-letters

Information Technology, Entry Level, Referral Cover Letter

Amy Martinez
21 Any Street
Norwood, MA 02062

September 1, 2021

Mr. David Foster, Head of Recruiting
Softco Ventures
55 Park Plaza
Boston, MA 02116

Dear Mr. Foster:

My name is Amy Martinez, and James Enriquez from TechSoft suggested that I contact you. He mentioned that you are seeking a new graduate to fill an entry-level software engineer position at your company, and I am writing to ask to be considered for the position. I recently graduated *magna cum laude* (3.75 GPA) from Boston University with a bachelor's degree in computer engineering. I have enclosed my resume, which details my qualifications and offers more information on how I might be an asset to your firm.

I believe that both my experience as a summer intern at Intel Corporation (during which time I gained experience with multiple languages, tools, and libraries, such as C++, Ruby, Visual Studio) and my time as a summer volunteer with IT CORPS (during which time I used my strong communication, organizational, and technical skills to help educate disadvantaged teens about careers in information technology) have provided me with excellent preparation that will allow me to immediately contribute to Softco Ventures. Additionally, I am very impressed by your firm's commitment to developing software and other technologies that assist people in disadvantaged communities to receive better access to social, educational, and health services, and I would love to join your team and help make a difference in the world.

I will contact you in the next few days to see if you have received my application materials and request an interview. Thank you for your time and consideration.

Sincerely,

Amy Martinez

Resumes

Once you have a degree or certification and some real-world experience, you'll be ready to apply for your first serious IT job. Usually, whether you even get an interview depends on your resume. "A powerful resume should leap off the page saying, 'Me! I'm the one you want to hire!'" advises software engineer Gayle Laakmann McDowell in her book *The Google Resume: How to Prepare for a Career and Land a Job at Apple, Microsoft, Google, or Any Top Tech Company.* You might be the perfect candidate but not get the job because of a poor resume, or you might be a subpar candidate and still get the job because of an exceptional resume. Here are a few pieces of advice:

- Take your resume seriously, don't just throw together a bulleted list.
- Provide detail, not just a list of job duties. Microsoft offers the following advice at its Web site: "Be sure to highlight your accomplishments in previous jobs—not just your duties. Do you have past projects to share? Include them as attachments or links to give us a better sense of your style."
- Keep it succinct, as one page, or maybe two, should be sufficient for most people. Remember, the purpose of a resume is just to get you an interview; the interview itself is how you get a job. So don't try to put your life story in the resume. Microsoft says that it is okay to use more than one page, but, with "that said, be sure your summaries are succinct and relevant—and that your most important information figures prominently on the first page."

If you are new to the IT field, your list of qualifications may seem too short. As long as you're applying for an entry-level job, this won't be a problem. Employers will understand that you're new to the field and they'll be looking for evidence that you can learn the job if hired. Therefore, it's still a good idea to include nonrelevant work experience, your grade-point average, and a statement of what you hope to get out of the job. All three factors will tell an employer if you will fit in and if you have the raw skills to become the employee they need.

It’s also a good idea to brag a little about any academic research projects you’ve been involved in, such as testing an old computer science theory with a new application, or a group paper you worked on about microprocessor scalability. Also emphasize any IT projects you’ve done on the side, such as repairing computers for local small businesses. Similarly, tell potential employers about your extracurricular technology-related interests. Do you build robots, make Web sites, or fix your own car? Are you a voracious reader or a successful athlete? Any of these areas are indications of your dedication and leadership skills. But remember that the stronger your technology experience, the less other aspects matter. So if you have some solid college experience, such as internships and help-desk jobs, then it’s probably not relevant that you also worked at a pizzeria or played rugby. On the other hand, if you were the treasurer of the university’s student government, that might impress a hiring manager, even though it’s not directly related to computers.

You’ll also want to include examples of your work. Summarize schoolwork that you’re proud of, like a senior or graduate thesis, a software program you wrote or helped develop, or an electronics part that you designed. Give concrete examples of your results. If you wrote a program that increased efficiency by 25 percent in your department, note that in your resume. It shows employers what value you bring to the company.

Above all else, reread your resume and cover letter several times before you click the “send” button in your e-mail program. Have friends and others read it, especially anyone who you think writes well. Being a solid writer isn’t an automatic requirement for getting an IT job, especially an entry-level one, but it definitely helps in showing that you have a solid professional presence. Even if communications skills have no bearing on the job at all, people will automatically eliminate any resume that is poorly written. Keep in mind that good writing isn’t just about spelling. Avoid clichés, don’t be wordy, and try to use active verbs rather than passive tenses whenever possible. You want to engage the reader and impress him or her with substance.

If you’re daring and the company to which you’re applying has younger managers, then consider taking a more creative approach to stand out from other job applicants. For example, create a Web page with your resume and other information about you. You’ll still need a regular, one-page resume for

most application processes, but here are some suggestions on what to include on your resume Web page, which some people call a social media resume:

- Basic information such as your name, educational background, current job title/employer (if applicable), certifications (e.g., Microsoft Certified Solution Developer, Project Management Professional), etc.
- A professional-quality photograph of yourself.
- A Welcome/Introduction section that explains why you created the site and its basic features.
- An Objective that briefly details what type of career you want and how you will bring value (increased profits, productivity, etc.) to the company that hires you.
- A Skills section that discusses your experience with C#, Java, JavaScript, C++, Python, SQL, PHP, Linux, etc. List Web links that show examples of your work with each.
- Links to your social-media sites, such as your blog, LinkedIn profile, Twitter handle, Pinterest site, etc.
- A multimedia portfolio or samples of your creative work (blog, podcast, video, animation, photographs, design work, etc.).
- A short video or MP3 in which you introduce yourself to employers (use this to show your personality and communication skills).
- Written, video, or audio testimonials from past employers and coworkers, or, if you're in college, professors and internship program directors.
- Keywords that are applicable to your industry and job titles that search-engines can pick up.

Resumes in the Age of COVID-19

When the COVID-19 pandemic struck the U.S. in early 2020, many companies transitioned their employees to working at home all or most of the time. Forty-two percent of U.S. senior managers surveyed by Robert Half Technology reported that they were advertising fully-remote jobs due to the pandemic. As a result, many new and experienced workers logged a lot of time working at home. If you worked at home a significant amount of time during the pandemic or for other reasons, it's important to emphasize your remote-work capabilities in your resume. Why? Because companies

continue to seek employees who were, and continue to be, successful in work-at-home environments. Here are some tips on what to include on your resume:

- In the Experience section, use a bullet point or two to reference the tasks that you did while working remotely and the success you had while doing them. In terms of success, you could state how you beat project deadlines, came in under budget (employers are increasingly concerned with efficiency and cost control), or successfully managed a team of remote workers who were located throughout the United States or world.
- When listing employers, be sure to note that you worked remotely for all or some of the time of your employment.
- In the Skills section, list your expertise (if applicable) in using Slack, Teams, and file-sharing, project management, or cloud-based software. Tip: Doing so will be especially useful if your target employer uses this software. This tells the employer that you can hit the ground running if you are hired.
- Learn some new skills to demonstrate your interest in self improvement. Take a class, earn a certification, attend a virtual conference, or do something else that helps you to expand your skill set and knowledge. Employers like to see job applicants who are interested in self-improvement and are willing to makes themselves better employees.

Here are some Web sites that provide tips on creating an effective resume:

- How to Write a Resume for IT: https://www.monster.com/career-advice/article/how-to-write-a-resume-for-it
- Technology Resume Samples: https://www.monster.com/career-advice/article/technology-resume-samples
- How To Write A Great IT Resume: https://community.spiceworks.com/how_to/41357-how-to-write-a-great-it-resume
- Procrastinating on Your Resume? Five Steps To Writing A Resume Quickly And Easily: https://www.forbes.com/sites/carolinecenizalevine/2018/01/27/procrasti

nating-on-your-resume-five-steps-to-writing-a-resume-quickly-and-easily/#5ec42ecb2f78

- 11 Amazing IT Resume Examples: https://www.livecareer.com/resume/examples/information-technologyInformation Technology Resume Tips and Examples: https://www.thebalancecareers.com/information-technology-it-resume-examples-2063601
- 4 Tips to Boost Your Tech Resume During COVID-19: https://insights.dice.com/2020/06/30/4-tips-boost-your-tech-resume-during-covid-19
- Boosting Your Resume: Tips to Maximize Your Job Hunt During COVID-19: https://www.salliemae.com/blog/bolster-skills-online

Information Technology, Entry Level, Combination Résumé

Amy Martinez
21 Any Street
Norwood, MA 02062
Martineza2015@anymail.com
(777) 777-7777
http://www.linkedin.com/[yourLinkedInURL]

SUMMARY

- *Magna cum laude* graduate with a bachelor's in computer engineering from Boston University
- Completed a summer software engineering internship at Intel Corporation
- Volunteered with IT Corps, a nonprofit that educates 800 disadvantaged elementary, middle school, and high school students each year about technology through clubs and workshops

EDUCATION

Boston University, Boston, MA, 2017–2021, Bachelor of Science in Computer Engineering

- GPA: 3.75; Graduated *magna cum laude*
- Vice president, High Technology Society—planned club special events, organized membership drive, represented the university at statewide and national conferences
- Winner, East Coast Private University Robotics Competition 2016—built RhettBot, competed in software design, navigating an obstacle course, battery life, and PC synchronization functions

VOLUNTEER, WORK, AND INTERNSHIP EXPERIENCE

IT CORPS, Boston, MA, Summer 2019/Summer 2020, Volunteer

A nonprofit organization that educates 800 elementary, middle school, and high school students each year about technology through camps, clubs, and workshops

- Computing Career Corps Program: introduced middle and high school students to a variety of in-demand IT occupations including computer programming, software engineering, and robotics
- Coding Camp Program: Helped high school students to participate in hands-on, interactive coding activities that allowed them to learn about computer programming and develop critical thinking and problem solving skills
- Responded to telephone and e-mail queries during program registration periods

Boston University TechHelp, Boston, MA, Summer 2019
Supervisor, Help Desk Support

TechHelp is the university's student-staffed help desk and computer support department

- Supervised a team of 15 student consultants
- Prioritized faculty and student support issues and assigned technicians based on their skill sets
- Performed on-site hardware repair and software updates for students pursuing summer study

Intel Corporation, Hudson, MA, Summer 2018
Early Internship for Software Engineering Program

An industry leader in the development of hardware, software, and related services, with more than 100,000 employees in 63 countries

- Helped develop automated reports and performance benchmarking tests for MIC Software
- Wrote cleanup utility scripts in Python
- Exposed to multiple languages, tools, and libraries, such as C++, Ruby, and Visual Studio
- Named "Intern of the Month," July 2018

Information Technology, Entry Level, Combination Résumé, 1 of 2

JODY KELIN

Home Address:	*Cell: 609/123-4567*	*E-mail:*
12 Meadowbrook Drive	*Home: 732/123-4567*	*jkelin@email.com*
Lakewood, NJ 01234	*LinkedIn: (web address)*	

SUMMARY

Entrepreneurial information technology professional with proven track record of saving clients time and money. Started technical consulting business in high school, successfully providing support services to small businesses and individuals. Consistently demonstrate innovative suggestions for maximizing efficiency and service in the workplace. Excellent customer relations skills, well organized. Dedicated. Strong work ethic.

PROFESSIONAL EXPERIENCE

PRIVATE CONSULTING, Owner / Founder — 2010 – Present
Started own business providing technical consulting to small businesses as well as residential help.

- Provide extensive variety of technical help including troubleshooting, technical support, networking, and software development
- Offer training in hardware and software usage
- Establish and/or increase security for wireless networks and configure firewalls
- Consistently demonstrate technical abilities to retrieve critical data (when back up does not exist or files have been corrupted), restore information (by accessing old images from hard drive), execute temporary access to "lost data," resolve security breaches (to laptops on wireless networks)
- Exhibit strong interpersonal skills and consulting abilities with clients

SENIOR SALES ASSOCIATE, The Gadget Place — 2004 – 2010

Ran daily register reports and weekly payroll reports, and made daily bank deposits. Utilized AS/800 and other systems in order to achieve high level of customer service. Handled maintenance and upgrading of POS systems throughout store. Supervised a staff of 10 – 15 employees.

- **AWARDS:** Achieved Sales Associate of the Month 10 times; Recognized for highest % Replacement Service Guarantee 4 times; Highest % increase in sales from last year in volume group
- Worked 30 hours per week while carrying full-time college course load
- Demonstrated strong customer relations skills. Proven ability to match customer needs with appropriate products
- Instrumental in effort to make register sites more efficient and ergonomically correct, through the suggestion and subsequent installation of flat panel monitors and use of ergonomic mice and keyboards

CASHIER, Acme Foods Market — 1997 – 2000

- **AWARDS:** Cashier of the Month, Most Accurate Cashier, Quickest Cashier

EDUCATION

Combination Résumé: Computer Systems Consulting, page 1 of 2

Information Technology, Entry Level, Combination Résumé, 2 of 2

School of Arts & Sciences
Department of Mathematics and Computer Science
Bachelor of Science in Computer Information Systems
Relevant Coursework:

- Object Oriented Programming
- Computer Architecture
- Data Organization & Databases
- IT Security
- HCI & Usability Testing
- System Analysis and Web Design
- Project Management
- Data Communications and Networking

TECHNICAL SKILLS

PC Networks: Configuration and installation of routers, switches, and hubs; as well as wireless technologies including configuration of access points, routers, network storage, and printers

Operating Systems and Software: Windows 10, MS Office, MS Excel

Hardware: Mastery of PC hardware components and peripherals, troubleshooting, and installation including RAM, hard drives, various adapter cards, NIC installation, and configuration

Languages: Working knowledge of C++, JavaScript, Python, and HTML

PROFESSIONAL AFFILIATIONS

Association of Computing Machinery
Association for Women in Computing
IEEE Computer Society

PROFESSIONAL AFFILIATIONS:

CompTIA A+
CompTIA Network+
CompTIA Security+
CompTIA Server+

Combination Résumé: Computer Systems Consulting, page 2 of 2

Interviewing

Interviewing in This Industry

Technology interviews are no walk in the park. Interview processes vary as much technology employers, but many tech interviews feature standard elements—prescreening, tests, brainteasers, and peer interviews. Here are brief summaries of the interview process at some large IT companies:

- Google: There are two types of interview formats: phone/Google Meet interviews and onsite interviews. For software engineering positions, phone/Google Meet interviews typically last between 30 and 60 minutes. “When answering coding questions,” Google advises at its Web site, “you’ll talk through your thought process while writing code in a Google Doc that you’ll share with your interviewer. We recommend using a hands-free headset or speakerphone so you can type freely.” For all other positions, the phone/Google Meet interview will last 30 to 45 minutes. Prepare yourself to answer behavioral, hypothetical, or case-based questions that cover your role-related knowledge. During on-site interviews, interviewees meet with four Googlers (as Google employees are known) for about 30 to 45 minutes. These Googlers could be potential teammates, while others work in cross-functional roles. According to its career Web site, “all candidates will have the chance to highlight strengths in four different areas: general cognitive ability, leadership, role-related knowledge, and Googleyness.” Google provides detailed information on its application, interview, and decision process at https://careers.google.com/how-we-hire.
- Texas Instruments: Interviews may involve both virtual and onsite interviews. Virtual interviews typically last 30 to 45 minutes and cover behavioral questions and assess your technical skills for the role. During an on-site interview, you’ll typically meet with hiring managers and members of the team. Your interview might include lunch, a tour of the facility, and an information session about the role. Learn more at https://careers.ti.com/hiring-interview-process.
- Intel: When submitting their resume, applicants must answer a series of prescreening questions. Qualified candidates will be invited to

interview. According to the Intel career Web site, “your interview may be over the phone, Internet, or in person. We use behavioral-based and technical interviews to get to know you. What makes you passionate? What have you accomplished so far? We believe in two-way dialogue, so prepare to ask us questions as well!” Learn more at https://jobs.intel.com/page/show/candidate-help-desk.

- Microsoft: Interviewees typically meet with three to six people for up to an hour for each meeting. As an interviewee, Microsoft advises that you should “be prepared to demonstrate how you meet the requirements of the job description by sharing specific examples from your past, or ideas about how you would accomplish a specific task. For some of our openings you may be asked to write code, share a creative portfolio, or provide examples of your work in other ways.” Learn more at https://careers.microsoft.com/us/en/faq and https://careers.microsoft.com/us/en/interviewtips.

Prescreening

Many HR departments are understaffed and overworked. Before any actual face-to-face interview, many employers use third-party companies to prescreen applicants over the phone.

The prescreening interviewer’s job is to filter out candidates, so HR’s job becomes more manageable. Many of this interviewer’s questions will fish for reasons to keep people out. A question like, “How do you plan to get to work?” determines if you are easily able to get to the office on time.

Meanwhile, the interviewee must work to win a face-to-face interview. No answers should imply any problems with work, punctuality, personality conflicts, etc.

When asked, “Why did you leave such-and-such past job(s)?” the answer should be truthful but succinct and positive. Concentrate on future opportunities with something like, “I’ve had great bosses, although not all of them have been easy. But they all learned to rely on me. I’m hoping for another employer like that.” If the interviewer asks illegal questions, like

ones about family obligations, you should avoid a confrontation and instead emphasize that such obligations have never been a problem at work.

Without being able to read the interviewer's face or body language, these phone interviews can be challenging. Nevertheless, you must try to build rapport with the interviewer, because people want to work with people they like. To help yourself out, you can and should have your answers ready when a prescreening interviewer calls.

Additional resources:

- 4 Tips to Ace the Pre-Screen Phone Interview: https://www.bluesteps.com/blog/4-tips-ace-pre-screen-phone-interview
- 5 Phone Interview Tips to Master: https://www.monster.com/career-advice/article/mastering-the-phone-interview
- Screening Job Interview: Make the First Cut: https://www.dummies.com/careers/find-a-job/interviews/screening-job-interview-make-the-first-cut
- The Five Toughest Telephone Interview Questions—and How To Handle Them: http://www.careercast.com/career-news/five-toughest-telephone-interview-questions-and-how-handle-them

Video Interviews

The IT industry has long been a leader in using video interviews as a means to save time and money during the interview process. But the COVID-19 pandemic prompted many employers to move their hiring processes online to reduce the risk of transmission of the virus. You might already be a Zoom expert as a result of school or work but if you aren't, you must master this technology and learn how to present yourself effectively online. Here are some tips to help you prepare for and prosper during digital interviews.

- **Test your technology.** You don't want surprises when you begin the interview, so be sure to make sure that your Internet connection, camera, and microphone work correctly.
- **Practice makes perfect.** This will help you to feel comfortable on video and will help you to hone your communication skills, tweak

your body language, and otherwise shine during the interview. Tip: Record your practice sessions and review them to improve your presentation. Ask your friends to observe your mock interview and provide feedback.

- **Set up a distraction-free interview area.** This means a place that is away from noise (barking dogs, crying kids, loud traffic, etc.), does not have busy backgrounds or concert posters (these make you look like you're a kid, rather than a budding professional), and that is well-lit, but that's not located in a place where you will experience a strong glare from the sun. Tip: Remember to turn your phone off before the interview.
- **Dress like you're going to an in-person interview.** This will help you to convey professionalism and confidence. Tip: Dress from head to toe. Some people only dress professionally from the waist up, which can create a clothing faux paus if you have to suddenly stand up to adjust technology or get a missing document during the interview.
- **Be prepared.** Be ready with opening comments that will break the ice with the interviewers. This could relate to the company, information that you gleaned about the interviewer from LinkedIn, or other topics. This will make you appear relatable and comfortable with the video interview process.
- **Focus on your body language.** Everything you do during the interview sends a positive or negative message to the interviewer. For example, if you make good eye contact with the interviewer (via the web camera), you send a message that you are confident, open, and engaged with the interview process. If you spend most of the interview looking down or at different things in the room, you will seem unconfident or distracted—and no one wants to hire that type of worker. Other examples of good body language include sitting up straight, smiling (when appropriate), not fidgeting, and speaking clearly and slowly so that the interviewer can hear and understand you."

Here are some additional resources to help you ace your video interview:

- Virtual/Phone/Video /Zoom Interviews: https://career.vt.edu/job-search/presenting_yourself/interviewing/types-locations/phone-

interviews.html

- 8 Tips For Acing Your Next Virtual Interview: https://www.northeastern.edu/graduate/blog/virtual-interview-tips
- 9 Tips For Mastering Your Next Virtual Interview: https://online.hbs.edu/blog/post/virtual-interview-tips
- Top Video Job Interview Tips: https://www.roberthalf.com/blog/job-interview-tips/screen-time-how-to-nail-your-next-video-interview
- 22 Phone Interview Tips to Help You Nail the Call (and Move to the Next Round): https://www.themuse.com/advice/phone-interview-tips-preparation
- 20 Video Interview Tips to Help You Dazzle the Hiring Manager and Get the Job: https://www.themuse.com/advice/video-interview-tips
- Video Interview Guide: Tips for a Successful Interview: https://www.indeed.com/career-advice/interviewing/video-interview-guide

Tests

Tests are very common for entry-level IT jobs. Sometimes a company will have a standard test for everyone; sometimes the interviewer will test you based on your personal experience and stated ambitions. Other times the test will be a list of multiple-choice questions; or they'll sit you down in front of a computer and give you a task to complete.

To find the right fit, employers have been using more and more drug tests, background checks, credit checks, and personality tests. Approximately 60 percent of companies now use personality tests, according to *The Wall Street Journal*. There are no right or wrong answers for many of the personality test questions; the employers simply want to see if your personality would fit their offices.

Peer Interviews

If the prescreening interview goes well, the applicant may face a series of highly technical and intellectually demanding face-to-face interviews. These interviews may make an interviewee wonder where the casual,

conversational interviews of the past went. Nowadays, IT companies may send an applicant on several grueling peer interviews in one day.

“[Peer interviews seem] to be very common. It’s the whole idea of peer interviewing, that you’re interviewed not by a human resources person, but by the people you’re going to be working for,” says William Poundstone, author of *How Would You Move Mount Fuji? Microsoft’s Cult of the Puzzle —How the World’s Smartest Companies Select the Most Creative Thinkers* and other IT career planning books. “There are a lot of good things you can say about [peer interviewing], because really, in a technological field, obviously the people actually in the field are in a better position to assess your experience and skills than someone in human resources.”

Peer interviewing does have drawbacks. IT peers are often young and inexperienced at interviewing. “One of the negatives is that you do have these tough interviewers who like flunking people in a way and I don’t think you’d have that if it was human resources people so much,” explains Poundstone. Also, peer interviewers are programmers, database administrators, etc., rather than HR employees who are paid to talk to candidates. “They tend to see this as you’re taking up their time. So, they want to make sure that they make this really hard and they really act as the gatekeeper, making sure that the people that they see as lesser qualified aren’t coming into the company,” says Poundstone. “At Microsoft and other places, there are people who just like to veto a lot of job applicants by asking really hard questions and grading them, as it were, on a really tough curve.”

Finally, companies can afford to be harsh in interviews. Poundstone warns that some peer interviewers try to shake up candidates, “particularly in companies where they really do know that there’s this numerical advantage —that they’ve got 20 applicants for this one position and they have this luxury of being very choosy. Some of them just like to rattle applicants. It becomes almost like a fraternity hazing thing, like everyone there has been through this gauntlet of really hard puzzle type questions, so they’re just determined that everyone else after them is going to have to go through this as well.”

Peer interviewers want a candidate that fits their environment. Employers are looking for people who complement the manager's personality and that fit the team's way of thinking. Their view is that it's much easier to manage 10 people who all think similarly than nine like-minded people and one brilliant, but outside-of-the-box thinker.

Additional resources:

- How to Master the Peer Interview: http://money.usnews.com/money/blogs/outside-voices-careers/2015/01/13/how-to-master-the-peer-interview
- Peer Interviewing: https://hiring.monster.com/employer-resources/recruiting-strategies/interviewing-candidates/peer-interviewing
- 30 Behavioral Interview Questions You Should Be Ready to Answer: https://www.themuse.com/advice/30-behavioral-interview-questions-you-should-be-ready-to-answer

General Interview Questions

All applicants must typically endure questions on salary requirements, where they see themselves in five years, what their biggest flaws are, and how they describe themselves. The candidates should keep in mind that every answer must relate directly to the job. The job seekers should study the company and job descriptions a couple days before the interview, to give themselves an extra boost of confidence.

Q. How do you describe yourself?

The answer should concentrate on key, relevant accomplishments that show that the applicant can handle and contribute to this job.

Q. What is your biggest flaw?

This question can be tricky. The answer, "I'm a perfectionist," has been done to death, so employers do not find it useful. "I pay too much attention

to detail," is a better answer. Either way, however, the point of this question is to see how the interviewee deals with problems. Thus, the answer must explain how the job seeker works to solve things. "I am my own worst critic, but I'm taking time each day to feel good about my accomplishments" is a constructive answer.

Q. Where do you see yourself in five years?

One good answer is "With the same company. I'm looking for a stable, long-term situation."

Q. What are your salary requirements?

There are many possible answers to the salary requirement question. One answer is, "This is my current salary and I'll consider your best offer." Another possible answer is, "Although I'm at a junior level, I have had good internship and education experiences, and my salary is negotiable." Sometimes, however, employers demand a specific number. In such cases, Internet searches can easily help find salary calculators. Requesting salaries that are too high or too low scare off employers, so median ranges are safest.

Q. Why is your degree in a different field than the work you are pursuing?

A good answer could be something like, "That was my academic interest, but my work experience has been in this field." Another possibility is, "I chose a major easily applicable to any field."

Additional resources:

- Grow Your Technical Skills with Google-Coding Interview Questions: https://techdevguide.withgoogle.com
- 13 Insider Tips for Acing Your Job Interview: http://www.infoworld.com/article/2851128/it-careers/13-tips-ace-your-it-job-interview.html

- How to Prepare for (and Ace) the Technical Interview: http://www.cio.com/article/2383000/careers-staffing/how-to-prepare-for--and-ace--the-technical-interview.html
- 9 Ways to Ace the IT Executive Interview: http://www.cio.com/article/2383415/careers-staffing/9-ways-to-ace-the-it-executive-interview.html
- 10 Tips to Prepare for an IT Job Video Interview: https://www.cio.com/article/2382303/10-tips-to-prepare-for-an-it-job-video-interview.html
- 15 Ways to Screw up a Job Interview: http://www.computerworld.com/article/2867247/15-ways-to-screw-up-a-job-interview.html
- What Not to Wear to an IT Job Interview: http://www.networkworld.com/article/2271359/careers/what-not-to-wear-to-an-it-job-interview.html
- Information Technology Job Interview Questions: https://www.thebalancecareers.com/information-technology-it-job-interview-questions-2061206

Position-Specific Questions

Interview questions will also vary depending on the position you're applying for. Here are some sample interview questions (and suggested answers) for entry-level positions in desktop support, network support, programming, and work as a webmaster.

Desktop Support

Q. What platforms and applications are you experienced with?

Long before you answer this, try to find out the employer's platform preference (what kinds of computers and operating systems they like) and which applications (software) they use. Then answer accordingly. Of course, you don't want to lie. If the company uses some obscure platform that you've never heard of and software only found in countries that begin with the letter Y, then perhaps it's not the right job for you. More typically,

most companies such as Dell, Hewlett Packard Enterprise, and IBM use mainstream platforms, or they use clones. For operating systems, most companies typically run either a version of Unix or Windows, or MacOS if they use Apple systems. In software, everyone knows Microsoft Office, but again, try to find out ahead of time what else the company uses and then learn as much as you can about that software.

Q. What is your approach to PC troubleshooting?

There's not a "right" answer to this question, but, in general, the most efficient way to handle PC troubleshooting is a combination of analytical and empirical methods. Your answer should reflect this, and include some examples of unique problems you've encountered and how you solved them. You should do some name-dropping of technology terms so it's clear that you speak the IT staff's language. You should also talk about how you solve problems by collaborating with your peers.

Q. What's your style for dealing with frustrated people?

This question is very important: think about how frustrated YOU feel when technology fails and some smug (or clueless) support agent is trying to help. Smug or clueless are the last things you want to be, so explain how you'd use patience and politeness to calm the user, how you'd ask questions in a calm but not condescending tone, and how you'd confidently and comprehensively fix the problem. It's okay to use a little humor, as long as you don't seem sarcastic to the person you're trying to help.

You should emphasize that you would ask the user to show you exactly what he or she was trying to do when the problem happened, and then show them the proper or alternative way of accomplishing the task (don't just emphasize what they did wrong; that insults people's intelligence). When you're finished helping someone, as with any customer support issue, remember that a pleasant demeanor and a smile go a long way toward making people see you as the friendly IT guy or girl, not the obnoxious nerd.

Network Support

Q. What kind of networks have you built or maintained?

The most common corporate networks are ones using TCP/IP over Ethernet —that's "transmission control protocol/Internet protocol" and Ethernet is the physical and data signaling protocol. If you've built a home network (or a wireless network), it probably uses TCP/IP and Ethernet. Start by telling the interviewer about your experience with this. If you've worked with other network types mention that, too.

Q. Have you worked with remote access products?

Remote access used to mean just dial-up technologies, but today it also means network access from mobile devices, knowledge of virtual private networks, and knowledge of extranets. If you haven't worked with the newest technologies, say so, and move on. However, it would definitely help if you show that you at least know what they are.

Q. What are your thoughts on network security?

Network security is an active and growing field, far beyond the scope of this book. If you don't have any security experience, try to read up on it before the interview. A good place to start is the Information Systems Security Association (https://www.issa.org).

Junior Programmer

Q. Which programming languages do you know?

In academia, most people learn BASIC first and then advance to more serious languages and tools like C, C++, COBOL, Java, and others. But if you're a self-taught programmer and learned out of the traditional order, many employers value that, too. Don't just rattle off a long list of obscure languages—try to list them in some kind logical order and emphasize the

ones that you know best. Also, try to emphasize languages that are used in the kind of the company to which you're applying. For example, if the company does a lot of computer-aided design and drafting (CADD) work, then talk about how you are familiar with Autodesk's CADD programs; if the job involves working with a database, talk about your SQL experience.

Q. Which language is your favorite and why?

This is another question with no right answer. Most programmers have a favorite language, just as an artist has her favorite materials. Talk honestly and passionately about why you prefer Java instead of Microsoft's .Net, or why you enjoy working in C++ more than other languages. It's very important to bolster your preferences with technically sound arguments. It's also okay to talk about how you do understand the merits of a rival language but that you have a simple affinity for the style of another.

Q. What's the most complex program you ever wrote?

Again, just answer honestly. Explain what the program does, why you made it, what language it's written in, and what hardware it runs on. Explain the challenges you faced in designing it, the bugs you encountered, and how you fixed them. Explain how your program (even if it's a game) interacts with other programs. That's important: in the real world, no software acts alone. Most important of all, explain what you learned from writing the program and explain how you can use that knowledge if hired.

Webmaster/Web Developer

Q. What development languages/tools can you use, other than HTML?

Everyone knows how to make simple Web sites in HTML (hypertext markup language)—all you need is Windows Notepad or other software, a copy of *HTML for Dummies*, and a $10-a-month hosting account. It's really very easy, but it's not impressive. Instead, focus on the serious tools that you know how to use, such as CSS, Go, C#, JavaScript, Ruby, and Python.

Show the interviewee that you know how to use these tools for business, not just for fancy graphics and other bandwidth-hogging junk.

Q. What's your idea of a good Web site vs. a lousy one?

Here's your chance to talk about efficient designs and site usability. Talk about your knowledge of how a good Web site has powerful back-end tools and infrastructure. Explain how you understand the difference between a Web site that just looks good, versus one that actually does something to help people to save money or time. Talk about site reliability, speed, and software and mobile compatibility.

Q. Do you have any design or editing skills?

For the customer-facing parts of a Web site, it is important to invoke solid creative, design, and editing skills. No matter how good your company's product is, no one will buy them if your Web site looks like a bratty child designed it. So bring along screen captures of your own Web site, or captures of sites that you think illustrate how to do it right. Also, talk about any art or writing experience you have.

Brainteasers

Puzzle-style questions enjoy immense popularity in IT interviews. "I get the impression that at least two thirds of [tech] companies tend to ask at least some of these types of questions," says William Poundstone, author of *How Would You Move Mount Fuji? Microsoft's Cult of the Puzzle—How the World's Smartest Companies Select the Most Creative Thinkers* and other IT job-search books. "People have told me that they've had five different interviews and each [interviewer] asked their favorite three questions. So, you end up doing 15 of these logic puzzles in one day of interviewing."

"There are several reasons [for this]," explains Poundstone. "The one that they usually articulate is that it has something to do with the pace of technological change. There's a feeling that, because the standards are changing so quickly, it's hard to hire someone specifically for one specific

skill set. So, they're really looking for mental flexibility and the ability to deal with new things. And that's what they're hoping to gauge with these types of puzzles."

Also, inexperienced peer IT interviewers tend to look online for trends in interviewing. Microsoft began asking these logic questions to applicants and others picked up the habit. "I suppose the Microsoft effect has been instrumental in popularizing these types of interviews, just in that there have been all these articles about Microsoft interviewing. And I think that has interested a lot of other companies in this," clarifies Poundstone.

"A third thing is just the whole economic picture, with so many companies downsizing. A lot of companies are finding that they're almost in the position that Microsoft has historically been in: of having very few open positions but an awful lot of applicants. And they're kind of desperate almost to get some systematic way of wading through all those applicants, so they figure that they'll give this a try."

Poundstone warns that this style of interviewing is so new that many interviewers do not know how to handle it. "A lot of companies that don't have a long history of asking these questions will just use that as license to ask any sort of crazy question."

Peer interviewers may ask incredibly difficult questions that do not relate much to the job. "One person said that he was asked, in an engineering job, to describe November," says Poundstone. "And when he pressed the interviewer for some sort of guidance as to what they were looking for, the interviewer just repeated, 'Describe November.' So the guy ended up talking about autumn leaves and Thanksgiving and so forth. Later, the interviewer explained that he had heard somewhere that good engineers give really precise answers. So he wanted something like November is the 11th month ending 22 days before the winter solstice, which seems like a silly interpretation of this question."

However, an interviewer's inexperience may also work in the job seeker's favor. Interviewers may ask non-effective, one-trick puzzle questions like "the one where you're supposed to take six matchsticks and arrange them to form four regular triangles," describes Poundstone. "And the intended

answer, which is really cute as a puzzle, is that you make a little tetrahedron, or pyramid, so it's three-dimensional. But once you've seen that answer, it's very easy to remember. Particularly in the age of the Internet, you have to figure that people are going to try to Google the answers if they hear about the [puzzle].

"A lot of people look at these puzzle-type questions as math questions. But it's important to realize that you're going to be graded on them almost as an essay question. They're really looking at your verbal explanation of your approach to the problem. And while they don't expect you to just zero in on the most efficient algorithm, they do expect you to give a good, compelling explanation of what you try, what you do next, and how you bounce back from this idea that didn't work out. And I think there is a real analogy there, between that and how people would solve problems that actually arise in business. So, you definitely want to be aware that you're being tested on, in a way, your verbal skills in explaining how you would approach this problem."

Poundstone highlights how to handle a difficult puzzle. "You have to realize that the first idea that pops into your head is probably going to be wrong. And yet, at the same time, you're supposed to be verbalizing your thought process. So, it really unnerves a lot of people, the idea that they're going to be talking about something that is wrong. But the way to deal with that is to introduce the obvious answer that pops into your head, with a tone of skepticism.

"You say, 'Well, the obvious approach would be this,' and then sort of analyze that obvious answer and show why it fails. While you're doing that, it's actually an excellent way of getting to understand the real dimensions of the problem. And usually, by the time that you come to the end of the explanation of why that answer is wrong, you'll have an idea of where you want to go to next. So it's a good way of filling the dead air and it does show your thought process."

Although brainteasers remain popular at some tech companies, Google no longer uses them. The tech giant explained the decision at its Web site, "our data showed that brainteaser questions didn't predict how well someone

would do on the job so we no longer ask them. Instead, we do work sample tests and ask structured interview questions."

Additional Resources:

- Beat Interview Brainteasers: https://www.monster.com/career-advice/article/Brainteaser-Interviews
- Brain Teasers Interview Questions: http://www.careercup.com/page?pid=brain-teasers-interview-questions
- Secrets to Answering the World's Hardest Interview Questions: http://www.time.com/3815965/hard-interview-questions

Be Ready to Ask Questions of Your Own

Preparing a list of questions to ask the hiring manager shows that you are interested in the company and that you have taken the initiative to fully understand the position. Microsoft says that "Thoughtful questions demonstrate your level of understanding, your interest, and your passions, so don't hold back. Your interview is an opportunity for you to get to know us, too." Here are a few suggested questions from Intel's career Web site:

- What exactly would I do in a position like this?
- What role does this type of position play in the company's technology mission?
- What is an average day like for this type of job?
- What are the growth opportunities in this type of position?
- What is the management structure like in this group?
- What advanced training and development opportunities are available in this role?

Careers in This Industry

Lifestyle Issues

Working in technology, you'll quickly find that some aspects of the lifestyle are very different from what you expected and that others are exactly what you expected—maybe even stereotypical. For example, working as a support technician at a rural city hall, at a medium-sized law firm, or at a global engineering services corporation will be very different experiences, even though your title and job description may be the same. This is also true for social aspects, dress code, stress level, and career path.

Irregular Schedules

Many jobs in IT require you to work nonstandard hours. For example, if you work for a large or international company that develops technology, it will likely have shifts, as in developers who work from 7 a.m. to 4 p.m., programmers who work from 4 p.m. to 11 p.m., and then overseas testers who work the next eight hours. That way, the developers come to work the next morning and the things they designed and planned for are programmed, tested, and ready for the next cycle. If you work in IT for a company that just uses technology, you'll be expected to be always available, whether by phone, text, Zoom meeting, or e-mail (integrated into the same device these days anyway). Even in nonemergency situations, you'll still have to work some weekends or nights, which is when IT staff tend to test new products or perform major system upgrades. (That way, it doesn't interfere with the regular course of business.)

Stress

Working in IT can be a crash course in diplomacy and precious "people skills." Many of your colleagues will approach technological challenges differently. For some people the bottom line is to get technology to work, no matter how ugly the solution (known as a kludge). Other people won't rest until they've solved an IT problem elegantly. Still others won't rest unless the solution is efficient and provides cost savings. Dealing with

stress is a big part of any IT job, whether your role is junior desktop support or chief technology officer. The so-called IT "fires" occur constantly. People run to you, call you, e-mail you, or text-message you, interrupting your family vacation to Disney World.

Injury

Aside from merely annoying daily tension, IT stress can result in physical injury. This is a serious issue that made "ergonomics" a household word. Spending too much intense time using a computer can cause injury to your back, eyesight, fingers, and neck (along with your heart and waistline, given that stressful IT positions often result in quick and unhealthy snacking in lieu of real lunches.) The U.S. Department of Labor's Occupational Safety and Health Administration offers advice and resources at https://www.osha.gov/computer-workstations, as does the Mayo Clinic at http://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/office-ergonomics/art-20046169. Sites like Healthycomputing.com also provide useful information. Using even more technology can help, too, as there are many products on the market designed to help you sit, type, and view in healthier and more ergonomic ways. There are even professional associations (such as the Human Factors and Ergonomics Society, https://hfes.org) and trade conventions (http://www.ergoexpo.com). Ergonomics and human safety also features in the study of "human-computer interaction," better known as HCI. HCI also has its share of companies and conferences. A good place to learn more is at the User Experience Professionals Association International's Web site, https://uxpa.org.

IT Culture and Stereotypes

Technology is more of a meritocracy than most other industries. And while spirited debates on technology subjects (known in the industry as "holy wars") inevitably occur, most employers discourage this kind of contention, especially at major companies in which large and disparate computing systems must literally work together. So try to keep this in mind when you show up for your new IT job.

Unfortunately, IT suffers from more gender stereotyping than many other industries. Women are employed at all levels of the IT industry and have been for many years, and some industry leaders are female (although their percentage remains quite low). Yet pockets of political incorrectness persist among men in the field. Examples range from men who wouldn't intentionally offend people, but who simply lack good social skills, to men who feel that only they can do solid IT work. There is also the serious issue of sexual harassment in the workplace. That's not to say that the IT industry tolerates inappropriate behavior any more than other fields, but it's impossible to deny that inappropriate beliefs about women (and behaviors) persist among some male workers. The good news is that this is slowly changing, largely due to the influx of women entering the industry during the Internet boom, renewed attention on the serious issues of sexual harassment by the #Me Too Movement and IT organizations such as Women in Technology, and the attrition (by age and layoffs) of the he-man-women-haters club.

Off-hours labor and the sporadic eating habits this precipitates are factors more specific to IT. There is a stereotype of the single male IT worker surrounded by empty bottles of Coke and half-eaten Twinkies. There are many cases where this is absolutely true. But there are just as many cases where it's completely false. Yes, there are scores of real nerds, but there are also health nuts, family men, women, and fitness enthusiasts. Many IT companies have taken steps to offer their employees access to healthful food in company cafeterias and access to corporate gyms for regular exercise.

Salaries, Benefits, and Job Satisfaction

Although the work environment can sometimes be challenging, good pay and strong benefits at many IT firms offset these drawbacks. Those employed in computer and mathematical careers earned mean annual salaries of $88,240 in May 2019, according to the U.S. Department of Labor. This is much higher than the mean salary for all occupations, $53,490. Robert Half Technology reports that salaries for chief technology managers, chief information officers, chief security officers, directors of technology, and other high-level executives can exceed $275,000.

Fringe benefits are generous at many tech companies and other employers of IT workers. According to Robert Half Technology's *2021 Salary Guide for Technology Professionals:*

- 68 percent of companies offered medical insurance
- 63 percent offered paid time off
- 59 percent offered dental insurance
- 55 percent offered access to a retirement savings plan
- 46 percent offered flexible work schedules or telecommuting options

Job satisfaction is high in the IT industry. Seventy-two percent of IT professionals surveyed by IT and professional training firm Global Knowledge in 2019 reported being satisfied with their jobs.

Talk Like a Pro

Glossary

3D Printing
A printing process in which computer-aided design software and a special printer are used to create entire objects—from smartphone cases and car parts, to medical equipment and artificial organs—more efficiently and less expensively than if they were created using traditional manufacturing processes.

algorithm
A set of instructions that allows a computer to perform a specific task or group of tasks.

alpha
The first primary test version of a computing system.

angel investor
Typically, an extremely wealthy individual who provides backing to a very early stage business or venture.

appliance
Any networked computing system that ships on custom hardware.

application
A computer program that is designed to perform a specific function such as

word processing, building a database, obtaining information, or creating spreadsheets; also known as an **app.**

application programming interfaces
Programs that help other people connect to your computer.

artificial intelligence
Technology that can be programmed to make decisions which normally require human thought and act independently of humans.

augmented reality
Technology—a special headset or applications on a smartphone or tablet—that allows users to integrate virtual objects into the real world.

autonomic
A term favored by IBM, meaning computing systems that fix themselves.

backup
The process of making copies of data at regular intervals to protect data from being lost.

beta
The second, almost-finished version of a computing system.

Big Data
The term for a collection of large datasets (a dataset is a group of two or more data points) that cannot be analyzed effectively by using traditional statistical methods.

binary
The most common numerical system (using only 0 and 1) in computers.

black lists
Software for blocking specific e-mail addresses.

blockchain technology
A distributed ledger database that maintain a continuously-growing list of records that cannot be altered, except after agreement by all parties in the chain.

blog
An often informal online journal that is updated regularly and appears in reverse chronological order; blogs also often contain photographs, videos, and links to other sites.

broadband
A type of communications system in which the medium used for transmission carries multiple messages simultaneously. This form of communication is typically for wide area networks.

browser
User-friendly software that makes Internet searches quicker and more efficient.

bug
An error in computer coding or logic that causes a program to function incorrectly or to produce incorrect or unexpected results.

certification
A credential awarded by a professional association to applicants who meet educational and experience requirements and pass an examination. IT professionals who are certified typically earn higher salaries and have a better chance of landing a job than those who are not certified.

chargeback
A technique for tracking how much of a computing system a department is using, based on corporate budgets.

cloud computing
A type of computing on the Internet in which individuals and companies store and access data, utilize application software, and perform other tasks —which they could only do on their own computers in the past.

cluster
A group of identical computing systems, linked together for reliability.

coding
A slang term for programming.

compiler
Special software for translating programs into raw data.

computer vision
A sub-specialty of artificial intelligence in which huge neural networks with many layers of processing units are used to teach machines how to view and interpret the world around them by using data collected by cameras and other methods.

cookie
A simple piece of data that a Web server stores on a client system. It is used to identify users, to instruct the server to send a customized version of a particular Web page, to submit account information, and so on.

cryptocurrency
A digital cash system that is increasingly being used as a substitute or complement to traditional currency. Cryptocurrency payments are not processed through a central banking system or trusted third party, but are sent from payer to payee. Bitcoin is the most-popular cryptocurrency.

customer relationship management
The trend of using technology to give customers better support while also saving money for a company and helping sales reps stay on top of their leads and active accounts.

data analytics
The acquisition, organization, and analysis of data to meet a variety of goals.

data mining
The process of analyzing data to find commercially useful relationships or patterns. It's what enables sites like Netflix to recommend other movies you might enjoy based on your (and others) recent picks.

data science
The development of new types of data analytic methods by tapping increased computing power and using algorithms, predictive models, and other methods.

data warehouse
The hardware/software equivalent of a big room full of databases.

database
A collection of information stored on a computer or other digital device or in the cloud. The software equivalent of a filing cabinet.

deep learning
An artificial intelligence sub-specialty in which huge neural networks with many layers of processing units are used to teach computers to recognize speech, identify images, and even make predictions.

developer
A person who designs the concept and planning of computing systems, which are then built by programmers (such as an architect vs. a builder).

DOS
Disk operating system; the interface between the user, the programs stored on hardware, and the hardware itself.

dot-com
Slang for a company that does the majority of its business on the Internet; the term also refers to the business boom of tech companies that started in the late 1990s and ended in 2000.

electronic commerce
The process of buying and selling products and services on the Internet; also known as **e-commerce.**

electronic funds transfer software
Software systems that are used to complete financial transactions electronically.

encryption
The technique of making data unreadable to anyone who doesn’t have a special “key.”

feed
A frequently updated stream of digital content.

fiber optics
A technology that uses pulses of light to send data/information through transparent fibers; many companies now offer Internet and television service via fiber-optic technology.

FinTech
Stands for financial technology. Any instance in which technology is used to help companies manage the financial aspects of their business.

firewall
Hardware/software combinations that protect a network from outside attacks.

gigabit ethernet
A high-speed networking technology (also, 10 gigabit Ethernet, which is exponentially faster and more expensive).

green computing
The study and practice of using computing resources efficiently. The goals are to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote recyclability or biodegradability of defunct products and factory waste.

hack
While the term often has nefarious connotations, it simply refers to creatively altering the behavior of an application or operating system by

modifying its code rather than running the program and using it in the traditional manner.

hacker
A person who enjoys working on machines for the pure education and thrill of it (largely distorted by the media to mean “a high-tech criminal”).

hardware
The physical components of a computer system; they typically include the motherboard, disk drives, display, keyboard, and the central processing unit.

holy wars
Any debate of “which is better” among technology workers.

HTML (hypertext markup language)
A code that helps control the way information on a Web page is transferred and presented and the way that hypertext links appear on the page.

hypertext
Refers to text with references (called hyperlinks) to other text that the reader can immediately follow, usually by a mouse click. The World Wide Web is the largest example of hypertext.

input devices
Hardware such as keyboards, scanners, and video cameras.

integrated circuit
Also known as a **microchip,** this is a miniature electronic circuit that contains several connected elements, such as transistors (these assist the flow of electricity) and resistors (these resist the flow of electricity).

Internet
A worldwide system of computer networks connected to each other.

Internet of things
Refers to the trend of creating everyday objects with sensors that allow them to connect to the Internet. Examples include a light bulb that uploads data about energy consumption; devices that are attached to keys that allow them to be quickly located if lost; and monitors attached to newborns that send real-time information about a baby's breathing, skin temperature, body position, and activity level to smartphone to help parents prevent Sudden Infant Death Syndrome.

Internet service provider
A company that provides Internet access to users.

Intranet
A network designed for use within a company or organization. It often uses applications associated with the Internet, such as Web pages, FTP sites, and e-mail, but is accessible only to those within the company or organization.

legacy system
Any computing system that’s considered old or just isn’t used anymore.

licensing
The process of purchasing permission from a technology company to use a certain amount of its product for a length of time.

Linux
A freely distributed, Unix-like operating system, where anyone can make changes but they must share those changes with everyone.

load balancing
The technique of sharing the computing workload across computing systems.

machine learning
A method of data analysis that incorporates artificial intelligence to help computers study data, identify patterns or other strategic goals, and make decisions with minimal or no intervention from humans. Examples of machine learning include the self-driving car and online recommendations from Netflix.

mainframe
Also called a “supercomputer,” this is a high-level computer designed for intensive computing tasks. A mainframe computer is often shared by multiple users, who connect to it through terminals.

malware
An umbrella term combining the words malicious and software, and used to refer to a variety of forms of hostile, intrusive, or annoying software or program code, such as worms, viruses, Trojan horses, and more.

memory
A device where information can be stored and retrieved. This may be a hard drive or external devices, or the RAM that is connected directly to the computer.

middleware
Software that connects other software components or applications. It includes Web servers, application servers, and similar tools that support application development and delivery.

mixed reality
A combination of virtual and augmented reality technology in which users can interact with virtual worlds and use real-world objects.

mobile browser
A browser that is designed to be used on a mobile device such as mobile phone.

multimedia
Content that appears in a variety of forms, such as audio, video, photographs, and text.

NAS
Servers specially designed for storing data, often built as appliances.

natural language processing
An artificial intelligence sub-specialty that aims to teach computers to understand, interpret, and manipulate spoken and written human language.

network
Two or more computers that are electronically connected to share data and programs.

open-source
The concept of sharing programs freely with anyone, as long as people also share any changes or improvements they make to the program.

operating system
The primary software that people use to interface with a computer, on top of which other software resides.

outsourcing
The concept of paying a specialty company to administer your company's information technology.

podcast
An audio recording that is available for download; people subscribe to the podcast so that they can listen to it at their leisure on a portable device or computer.

program
Lists of computer code that make a machine perform a certain task (aka

software or applications).

programming
The craft of creating software by mastering a language.

programming language
The form of instructions used to run computer programs; popular languages include Python, Java, JavaScript, Ruby, and C++.

putting out fires
The industry phrase for dealing with the various IT emergencies that happen throughout a typical day.

quantum computing
A type of advanced computing in which quantum computers are used to solve challenges of massive size and complexity that cannot be solved by the computing power of traditional computers.

routers
Technology for passing data between network segments.

search engine
A specialized Web site that uses software robots called spiders to help users find information on the World Wide Web. Users request searches by typing in keywords, or topical words and phrases, and the search engine displays a list of links to related Web sites.

search engine marketing
The process of increasing visibility or traffic on search engines by using search engine optimization and/or paid search advertising.

search engine optimization
The process of finding key words or phrases that will be picked up by search engines.

server
A business-class computer that holds data or programs for other computers to use.

Silicon Valley
A term for the region of Santa Clara Valley in California that is a tech industry hub.

smart contracts
In regard to blockchain technology, computer code that is stored on a blockchain that allows certain actions to be executed without human approval under specified circumstances.

smart phone
A handheld telecommunications device that offers advanced features beyond those offered by a typical mobile phone; these features include the ability to take photographs or video, send and receive e-mail, and access the Internet.

social
Refers to the increasing use of technologies that are accessible (and popular) with large groups of people.

social computing
E-mail, blogs, instant messaging, social-networking sites, social-bookmarking applications, wikis, and other software applications that allow people to interact.

social media
User-created content (audio, text, video, multimedia) that is published and shared on social media sites such as Facebook, LinkedIn, and Twitter; it can also be defined as the online technology that allows users to share content.

social networking
The act of interacting with others in an online community.

social networking sites
Web sites such as Facebook, Twitter, and LinkedIn where users can create biographical and/or professional profiles; post text, video; photographs, and audio; add friends; and communicate with other social media users.

software
Programs that tell the hardware what to do and how to do it. In general, software can be thought of as one of two types. System software refers to a computer's operating system. Applications perform the tasks for which

people use computers—for example, word processing programs, spreadsheet programs, and databases.

software as a service
A means of providing applications to customers on demand. With this type of technology, software vendors may make the application available for download on its Web site, or the application may be sent to a user's computer, laptop, tablet, smart phone, or other device.

spyware
Software that is installed surreptitiously on a personal computer to intercept or take partial control over the user's interaction with the computer, without his or her specific consent. Spyware programs can collect various types of personal information, such as Internet surfing habits and sites that have been visited, and can also interfere with user control of the computer in other ways, such as installing additional software and redirecting Web browser activity.

start-up
A young, innovative company that seeks to develop a unique product or service, or significantly improve an existing product or service. They are often found in the tech and health care sectors.

storage device
Device such as a CD-ROM, DVD-ROM, or external hard drive or flash drive that stores computer files outside of the computer.

streaming media
Audio or video that can be listened to or watched online, but not downloaded; streamed audio is also called a **webcast.**

tags
Keywords added to a Web site to help the site rank higher on search engines; tags are also used to help site visitors find related information at the Web site.

tape library
Computing systems using very large magnetic tape technologies for storing important but rarely used (or just old) data.

traffic
The number of visits a web page receives.

tweet
A real-time posting of text (limited to 280 characters or less).

Unix
A text-based operating system known for its reliability (compared to Windows); Unix has many variations or “flavors.”

venture capital
The process of investing in start-up or early-stage companies that have undeveloped or developing products or revenue.

virtualization
A technique for managing many physical computing systems as one virtual system; also, a technique for managing one physical computing system as many virtual systems.

virtual private network
A way to create a secure connection over a non-secure (public) network.

virtual reality
Technology (typically a headset that encompasses the field of vision) that allows users to immerse themselves visually, aurally, and through other sensations in imaginary worlds.

virus
An often-malicious program that infects a computer system by inserting copies of itself into certain files.

voice over Internet protocol
Telecommunications conducted over computer networks, instead of traditional phone lines, to save money.

wearables
Software applications that are worn or embedded in clothing or other objects that gather and analyze data to assist the user in his or her daily life or that are used for other purposes. They are often connected wirelessly to the Internet.

Web 1.0
The first generation of the commercial Internet in which Web sites were static and hierarchical in nature and did not allow visitors to create and contribute content.

Web 2.0
The second generation of Web sites that allow people with no little or no technical skill to create, edit, and publish their own creative content; popular Web 2.0 Web sites include Flickr, Digg, and Wikipedia.

Web 3.0
The third generation of the Internet that involves artificial intelligence, natural language search, data mining, and other technologies. There is much debate about what Web 3.0 entails.

Web page
An Internet document; typically a hypertext document, meaning that it provides links to related Web pages, either on the same Web site or on another Web site.

white hat hacker
An ethical hacker (often a computer security expert) who specializes in hacking (with permission) an organization's information systems to ensure that it is protected from unethical hackers.

white lists
Software for allowing specific e-mail addresses.

Wi-Fi
Technology that allows computing devices to communicate wirelessly.

wiki
A Web site such as Wikipedia in which any user can add and edit content.

Windows
The family of graphical operating systems from Microsoft.

World Wide Web
The entire collection of resources (text, audio, video, etc.) that are available on the Internet.

XML
“Extensible markup language” is a translator technology for any networked computing system, but mostly for Web sites.

Learn More

IT-Ready Prepares People for Information Technology Careers

Despite strong demand for information technology (IT) professionals, there is a shortage of IT workers in the United States. To address this shortage, Creating IT Futures, a nonprofit organization founded by CompTIA, has launched IT-Ready. This free education, training, and career placement program, which is available in select cities across the U.S., provides participants with the technical and personal skills needed to land an entry-level position in information technology, as well as earn CompTIA certification.

To be eligible for the program, applicants must:

- Live near an IT-Ready class location
- Be at least 18 years old
- Be a U.S. citizen or legal immigrant
- Demonstrate financial need
- Have a high school diploma or GED
- Commit to eight weeks of unpaid training, followed by a six-month paid on-the-job experience with an employer.

Visit https://www.creatingitfutures.org/it-ready/apply-to-it-ready for more information.

Computer Fun Facts

The IEEE Computer Society has many interesting facts about computers on its Web site. Did you know that:

- Grace Murray Hopper, while working on the Mark II computer at Harvard, found the first computer bug, which was a real bug that had been crushed in the jaws of a relay switch. She glued it to the logbook of the computer and thereafter when the machine stopped, told people they were debugging the computer. The very first bug still exists in the National Museum of American History of the Smithsonian Institution. (Visit https://www.computerhistory.org/tdih/september/9 to see a photo of the bug and logbook.)
- In the movie, *2001: A Space Odyssey*, Arthur C. Clark introduced HAL, the computer of the future and based it on the artificial intelligence proposals of I.J. Good and Marvin Minsky. Supposedly, HAL was the monosyllabic cipher of IBM.
- Less than four months after IBM introduced the personal computer in 1982, *Time* magazine named the computer its Man of the Year. Never before had an inanimate object been chosen for that honor.
- Ada Augusta King, Countess of Lovelace and the daughter of Romantic poet Lord Byron, translated a pamphlet on Charles Babbage's analytical engine. She added her own notes, as well as working closely with Babbage himself. She became recognized as the world's first computer programmer.

Sheryl Sandberg, COO of Facebook

Sheryl Sandberg is the chief operating officer of Facebook. She's been featured in many "best in tech" lists, including being named multiple times by *Forbes* as "The Most Powerful Women In Tech." Sandberg has had an eclectic career. Before starting at Facebook in 2008, she served as vice president of global online sales and operations at Google Inc., as chief of staff for the U.S. Treasury Department under President Bill Clinton, as a management consultant with McKinsey & Company, and as an economist with The World Bank (where she worked on health projects in India dealing with leprosy, blindness, and AIDS).

Sandberg holds a bachelor's degree in economics from Harvard University and was awarded the John H. Williams Prize as the top graduating student in economics. She earned a master's degree in business administration from Harvard University, graduating with high honors.

In 2013, Sandberg released her first book, *Lean In: Women, Work, and the Will to Lead*. It focused on the challenges women face in the world of work and offered encouragement and advice to those facing obstacles. *Lean In* quickly became a bestseller. She has served as a strong advocate for women in the workplace—especially in the IT industry. "Endless data show that diverse teams make better decisions," Sandberg told *USA Today* in an interview. "We are building products that people with very diverse backgrounds use, and I think we all want our company makeup to reflect the makeup of the people who use our products. That's not true of any industry really, and we have a long way to go."

After the unexpected death of her husband in 2015, Sandberg released *Option B: Facing Adversity, Building Resilience, and Finding Joy.*

Sources: Bloomberg Business, Forbes, USA Today

Advice for IT Job-Seekers

Alpaydin, Ethem. *Introduction to Machine Learning,* 4th ed. Cambridge, Mass.: The MIT Press, 2020. This resource discusses the use of statistics, pattern recognition, neural networks, artificial intelligence, signal processing, control, and data mining in machine learning.

Lowe, Doug. *Networking All-in-One For Dummies,* 8th ed. Hoboken, N.J.: For Dummies, 2021. This useful book in the For Dummies series offers detailed information on networks, certification, and industry trends. Mini-books within the book include Planning a Network, Network Administration, Protocols, Going Virtual, Remote Networking, Cloud Networking, Windows Server, Using Other Windows Servers, and Managing Linux Systems.

McDowell, Gayle Laakmann. *Cracking the Tech Career: Insider Advice on Landing a Job at Google, Microsoft, Apple, or any Top Tech Company,* 2nd ed. Hoboken, N.J.: John Wiley & Sons, 2014. This book was written by a former Google software engineer, who also served on Google's Hiring Committee. It offers information on crafting a winning resume; acing challenging coding, behavioral, and estimation questions; and breaking into niche fields (such as game design).

Mongan, John, Noah Kindler, Eric Giguere. *Programming Interviews Exposed: Secrets to Landing Your Next Job*, 4th ed. Hoboken, N.J., Wrox/John Wiley & Sons, 2018. This resource provides useful information on how online coding contests and the increasing use of candidate's public code repositories at GitHub are being used in the hiring evaluation process, emerging interview topics such as data science and machine learning, and much more.

Steinberg, Joseph. *Cybersecurity For Dummies.* Hoboken, N.J.: For Dummies, 2019. More than 2 million cyber incidents occurred in 2018, and they resulted in over $45 billion in losses, according to The Internet Society's Online Trust Alliance. As a result of rising cybercrime, demand is

increasing for cybersecurity professionals. This book will be useful to help aspiring IT security workers. It provides information on basic cybersecurity concepts, the types of cybercrimes, cybersecurity careers, and more.

Trivedi, Vinay. *How to Speak Tech: The Non-Techie's Guide to Key Technology Concepts*, 2nd ed. New York: Apress Media LLC, 2019. This useful resource provides an easy-to-understand overview of everything from common IT terms to emerging technology such as blockchain, augmented and virtual reality, Internet of Things, and artificial intelligence.

Robinson, Emily, and Jacqueline Nolis. *Build a Career in Data Science*. Shelter Island, N.Y.: Manning Publications Co., 2020. Strong employment demand exists for data experts to analyze the mountains of data that are collected by businesses, nonprofits, and government agencies. This book provides detailed information on educational requirements, building your professional network, career paths (e.g., consulting, in-house Big Data specialist, startups, public sector, or academia), and much more. Sections include Getting Started with Data Science, Finding Your Data Science Job, Settling Into Data Science, and Growing in Your Data Science Role.

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Hansen, Dustin. *Game On!: Video Game History from Pong and Pac-Man to Mario, Minecraft, and More.* New York: Square Fish, 2019.

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Reynolds, George. *Ethics in Information Technology.* 6th ed. Independence, Ky.: Course Technology, 2018.

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Torta, Stephanie, and Jonathan Torta. *3D Printing: An Introduction.* Herndon, Va.: Mercury Learning & Information, 2018.

Trivedi, Vinay. *How to Speak Tech: The Non-Techie's Guide to Key Technology Concepts.* 2nd ed. New York: Apress Media LLC, 2019.

Vermaat, Misty E., Susan L. Sebok, et al. *Discovering Computers 2018: Digital Technology, Data, and Devices.* Independence, Ky.: Course Technology, 2017.

Perceptions of Emerging Technology

Fifty-three percent of business executives surveyed by CompTIA in 2018 reported that they mostly felt a sense of excitement about emerging technologies (virtual reality, artificial intelligence, etc.). Twenty-seven percent said they felt equal parts excitement and trepidation regarding emerging technology, and 20 percent mostly felt a sense of trepidation. Opinions varied by type of emerging technology. The following list details which emerging technologies executives believed would have the least and most impact over the next four years:

- Machine Learning: 92 percent cited this technology as having an impact
- Internet of Things: 91 percent
- Blockchain: 90 percent
- Augmented Reality: 80 percent
- Artificial Intelligence: 79 percent
- Virtual Reality: 76 percent
- Drones: 72 percent

Visit https://www.comptia.org/resources/it-industry-trends-analysis to read the full list and to learn about trends in information technology.

Source: IT Industry Outlook 2018, CompTIA

Case Study: Maria Morales, Networking in the Information Technology Industry

Networking was a major tool in my job search. I recently graduated with a degree in software development, and networking helped me land an internship and then my first job in the IT industry. Networking works. Trust me. But you definitely have to go about it the right way—which I quickly learned.

Early in college, I wasn't much of a networker. I knew I needed to begin building my network, but I didn't really know how to go about it. I attended a few career fairs, met a few people, passed out my resume, but really made no headway. I met with a counselor at my college's career center, and he quickly got me on track. He gave me the following rules for networking at career fairs and related events:

1. Have a plan. Be clear what you want ahead of time—whether it's a mentor, an internship, job leads, or an information interview.
2. Focus on quality contacts over quantity. For example, it's better to make three quality contacts with fellow software engineering students and professionals (in my case), than 10 contacts with people outside of my specialty.
3. Help others by providing them with your opinions or intel on promising employers, fast-growing careers, internship opportunities, etc.
4. Follow up by thanking the networking contact for his or help and start building a real relationship.

At the next career fair I attended, I was ready for action. My plan: meet a possible mentor, or at least someone who was willing to participate in an information interview. My ultimate goal was an IT internship, but I decided to keep my expectations low. The event was a success. I really enjoyed

meeting some fellow software development students and exchanging notes about the industry and, of course, our contact info. I also met a woman with 10 years of experience in the software industry. She agreed to participate in an information interview. A week later, we met for about 20 minutes at a local coffee shop. She gave me a few important tips: join my school's computer club, participate in local coding competitions, join professional associations that offer student membership, and get on LinkedIn (she was really surprised that I hadn't created a profile).

I acted on all of her suggestions, most importantly, becoming a student member of the Association for Computing Machinery (ACM). Membership is less than $20. Benefits include access to a network of nearly 100,000 other members and association publications (including *XRDS*, a resource especially for students) and the opportunity to join a student chapter and several special interest groups that focused on software. One of the interest groups I joined needed volunteers to work at its annual conference—doing publicity, registering attendees, passing out conference brochures, etc. I jumped at the offer because my professor had always told me that volunteering with a tech association or charity was an excellent way to get noticed. I worked hard at the conference, but also had a chance to meet other people in programming and software development and attend a few seminars. The volunteer coordinator and I hit it off, and a few weeks later she e-mailed me to let me know about an internship program her company had just established for Latino women interested in entering the IT industry.

I applied for the internship and was accepted. The internship was great. I helped write code for the firm's data management platform, worked on internal support tools, and helped develop and update various internal and external software libraries. In addition to learning some new skills, I developed good friendships with some of the other interns and worked closely with software developers. Some of the developers were really cool and let me pick their brains about breaking into the industry, interviewing tips, hot software development jobs, and the industry as a whole.

During this time, I also continued to expand my network by participating in software development events, attending career fairs, volunteering with the ACM, and joining groups on LinkedIn such as Software Development

Professionals Group. I had frequent conversations with recruiters and a few software developers who were members of the group.

As my internship wrapped up, I began telling everyone in my network that I was looking for a full-time job and asked them to keep me in mind if they heard of an open position. Eventually, my networking was successful. One of my LinkedIn group contacts told me that his employer was hiring entry-level workers. I applied for the job, and also asked him to put in a good word for me. (That's pretty common; many companies ask their current employees to suggest potential new hires.) I also remember that one of my professors had worked at the company a few years back so I asked him to contact some of his former colleagues to recommend me.

I was called for an interview (actually several interviews), which I thought went well. (I reached out to my network for help preparing for the interviews.) Then I waited…and waited… and waited. I finally received the good news: the job was mine if I wanted it. Of course, I did! Networking has really helped me, and it can help you, too. I certainly had to have the right educational background, education, soft skills, and a relentless networking work ethic, but I wouldn't have a job today if I didn't use my network.

IT News and Insight

Association for Computing Machinery Careernews
https://www.acm.org/articles/careernews
This Web site collects the best articles about career planning and trends in the IT industry.

Build Your Career
https://www.computer.org/resources/newsletters/build-your-career
This biweekly, publication offers the latest career development news and advice. Recent articles included "Careers in Cloud Computing: Advice from an Expert" and "The Most Sought-After Computing Careers."

CareerCup.com
http://www.careercup.com
This Web site, which was created by Gayle Laakmann McDowell—a software engineer who has worked at Google, Microsoft, and Apple—provides free sample software engineering interview questions, a blog, and advice on resume preparation. It also offers fee-based career-preparation resources.

CompTIA IT Industry Outlook
https://www.comptia.org/content/research/it-industry-trends-analysis
This annual publication provides an overview of the IT industry, including its main divisions and popular career paths, as well as information on hot employment regions and industry trends.

CompTIAWorld
https://www.comptia.org/resources/comptiaworld-magazine
This publication focuses on new and evolving technology and how it's changing both work and home life.

Computerworld
http://www.computerworld.com
Computerworld is a leading industry publication that offers information on

hot careers and top employers, salaries, industry trends, and other topics that will help you land and keep a job.

CyberSeek
http://www.cyberseek.org
This Web site was created by CompTIA, Burning Glass, and the National Initiative for Cybersecurity Education to educate people about the strong demand for cyber security professionals. It provides information on hot cyber security jobs, states in which demand is strongest and weakest, and much more.

Dice.com
http://www.dice.com
This is a popular job site for those in the tech industry, with more than 53,000 job listings.

GlassDoor.com
http://www.glassdoor.com
Visit this site for user-posted information about jobs, companies, interviewing, and salaries.

Global State of Information Security Survey 2018
https://www.pwc.com/us/en/services/consulting/cybersecurity/library/information-security-survey.htm
This publication from professional services firm Pricewaterhousecoopers provides an in-depth look at trends in cybersecurity and the steps industry and governments are taking to stop cyberattacks.

Google’s Guide to Technical Development
https://techdevguide.withgoogle.com
According to Google's Web site, the guide "provides tips and resources to help you develop your technical skills through self-paced, hands-on learning. It is intended for university-level computer science students considering seeking an internship or full-time role at Google or in the tech industry generally; and university faculty; and others working in, studying, or curious about software engineering."

IEEE Internet Computing
https://www.computer.org/csdl/magazines/ic
This journal covers a wide range of topics for engineers, designers, and developers—from applications and architectures, to information management, and Internet security.

Information Security
http://www.infosecurity-magazine.com
This resource provides articles about emerging security threats and industry trends.

Information Technology Glossary
https://www.gartner.com/en/information-technology/glossary
This glossary from the research and advisory firm Gartner, Inc. features definitions of hundreds of IT terms.

MeetUp.com
http://www.meetup.com
This site allows you to find interest groups in your hometown. It's a great tool to locate IT networking groups.

Robert Half Blog
https://www.roberthalf.com/blog
This blog from a well-known staffing firm provides information for those seeking technology, accounting, finance, legal, administrative, creative, and marketing careers.

Robert Half Technology's 2021 Salary Guide for Technology Professionals
https://www.roberthalf.com/salary-guide
This guide offers comprehensive information on salaries and fringe benefits for IT workers in the United States and Canada, industry trends, and hot specialties and certifications.

SocialMediaToday
http://www.socialmediatoday.com
This Web site provides useful articles on social-media trends, blogging, technology, and related topics.

Software Magazine
http://www.softwaremag.com
Visit this magazine's Web site to learn more about industry trends and access a list of the top 500 software companies.

Startupers.com
http://www.startupers.com
Visit this Web site for job listings at start-ups; you can also post your resume.

Webby Awards
http://www.webbyawards.com
The Webbys spotlight the best of the web in the following categories: Websites; Advertising, Media, and Public Relations; Video; Apps, Mobile, and Voice; Social; Podcasts; Games; and Special Achievement. They are presented by The International Academy of Digital Arts and Sciences.

Wired
http://www.wired.com
This popular magazine offers articles about technology and culture and the latest breakthroughs in computer and Internet technology.

XRDS
http://xrds.acm.org
This is the student magazine of the Association for Computing Machinery. It provides profiles of hot IT careers, interviews with computer science educators, and information on scholarships.

Why Women Leave the Information Technology Industry

Women now comprise more than half of new computer science graduates and junior software developers, according to a 2018 study by the tech recruiting company HackerRank. Yet, despite improving opportunities and work environments for women in tech, many leave the field because of discrimination or for other reasons.

In 2017, the Kapor Center and Harris Poll surveyed U.S. adults who had left a job in a technology-related industry or function within the last three years to determine why they left. Here are some noteworthy findings from the center's*Tech Leavers Study:*

- The top two reasons why women overall left tech occupations were: "to seek a better opportunity" (cited by 33 percent of respondents) and "to leave unfair environments" (32 percent). The next most-cited reasons were "not satisfied with work environment (27 percent), "recruited away" (18 percent), and "not satisfied with their job duties" (21 percent).
- One in 10 women reported experiencing unwanted sexual attention in the workplace; 55 percent said this experience influenced their decision to leave.
- Twenty-seven percent of women reported that others took credit for their work, 25 percent reported being passed over for promotions, and 16 percent said that coworkers made assumptions about their abilities.
- Women in tech identified the following factors that would have encouraged them to stay with their previous company: better pay (cited by 73 percent of respondents), improved company leadership (69 percent), promotion (65 percent), greater work-life balance and schedule flexibility (65 percent), and a more positive and respectful work environment (63 percent).

Visit https://www.kaporcenter.org/tech-leavers to read the complete results of the survey.

Resources

For information on opportunities in the computer and video game industry, contact
Academy of Interactive Arts & Sciences
3183 Wilshire Boulevard, Suite 196 F13
Los Angeles, CA 90010-1211
http://www.interactive.org

Check out this organization's Web site for industry information.
American Society for Information Science and Technology
8555 16th Street, Suite 850
Silver Spring, MD 20910-2835
Tel: (301) 495-0900
E-mail: asist@asist.org
http://www.asist.org

For information on internships, student membership, and the ACM student magazine XRDS, contact
Association for Computing Machinery
1601 Broadway, 10th Floor
New York, NY 10019-7434
Tel: (800) 342-6626
E-mail: acmhelp@acm.org
http://www.acm.org

For information on artificial intelligence, contact
Association for the Advancement of Artificial Intelligence
2275 East Bayshore Road, Suite 160
Palo Alto, CA 94303-3224
Tel: (650) 328-3123
http://www.aaai.org

For information on career opportunities for women in computing, contact
Association for Women in Computing

PO Box 2768
Oakland, CA 94602-0068
E-mail: info@awc-hq.org
http://www.awc-hq.org

This is a membership organization for developers of desktop and laptop programs, software as a service applications, cloud computing software, and mobile apps. Visit its Web site for more information.
Association of Software Professionals
http://asp-software.org

For more information on cloud computing, contact
Cloud Computing Association
79 Main Street, 2nd Floor
Port Washington, NY 11050-2938
Tel: (212) 300-2520
E-mail: info@cloudcomputingassn.org
http://www.cloudcomputingassn.org

For information on careers, certification, continuing education, and free membership for students, contact
CompTIA
3500 Lacey Road, Suite 100
Downers Grove, IL 60515-5439
Tel: (630) 678-8300
http://www.comptia.org

For information on information technology research, contact
Computing Research Association
1828 L Street, NW, Suite 800
Washington, D.C. 20036-4632
Tel: (202) 234-2111
https://cra.org

For information on careers, certification, membership, and its mentoring program, visit
Digital Analytics Association

401 Edgewater Place, Suite 600
Wakefield, MA 01880-6200
Tel: (781) 876-8933
E-mail: info@digitalanalyticsassociation.org
https://www.digitalanalyticsassociation.org

DiMA bills itself as the "ambassador for the digital media industry: webcasters, online media, digital services, and technology innovators…and is the leading advocate for a stable legal environment in which to build ideas into industries, and inventions into profits." For industry information, contact
Digital Media Association
1440 G Street, NW
Washington, D.C. 20005-2001
Tel: (202) 792-5663
E-mail: info@dima.org
https://dima.org

To read Essential Facts About the Computer and Video Game Industry, visit
Entertainment Software Association
601 Massachusetts Avenue, NW, Suite 300
Washington, D.C. 20001-5369
E-mail: esa@theesa.com
http://www.theesa.com

For information on certification, contact
HDI
121 South Tejon, Suite 1100
Colorado Springs, CO 80903-2254
Tel: (800) 248-5667
E-mail: hdisupport@informa.com
http://www.thinkhdi.com

For information on computer forensics investigations, contact
High Technology Crime Investigation Association
4 Lan Drive, Suite 310
Westford, MA 01886-3576

Tel: (978) 364-5111
E-mail: contact@htcia.org
http://www.htcia.org

For job listings, career and job-search advice, and information on certification and careers, contact
IEEE Computer Society
2001 L Street, NW, Suite 700
Washington, D.C. 20036-4928
Tel: (202) 371-0101
E-mail: help@computer.org
http://www.computer.org

For information about information architecture and educational programs, contact
Information Architecture Institute
E-mail: info@iainstitute.org
https://www.iainstitute.org

For industry information, contact
Information Systems Security Association
1964 Gallows Road, Suite 310
Vienna, VA 22182-3814
Tel: (703) 382-8205
https://www.issa.org

For certification information, contact
Institute for Certification of Computing Professionals
244 South Randall Road, #116
Elgin, IL 60123-5529
Tel: (800) 843-8227
E-mail: office2@iccp.org
http://www.iccp.org

For information on computer forensics investigations and certification, contact
International Association of Computer Investigative Specialists

25 Catoctin Circle, SE, #2411
Leesburg, VA 20177-8767
Tel: (888) 884-2247
http://www.iacis.com

For information on opportunities in the computer and video game industry, contact
International Game Developers Association
1 Eglinton Avenue East, Suite 705
Toronto, ON M4P 3A1 Canada
E-mail: info@igda.org
http://www.igda.org

Visit the IWA Web site for information on its voluntary certification program.
International Web Association
556 South Fair Oaks Avenue, #101-200
Pasadena, CA 91105-2656
Tel: (626) 449-3709
http://www.iwanet.org

For information on certification, contact
(ISC)²
311 Park Place, Boulevard, Suite 400
Clearwater, FL 33759-3994
Tel: (866) 331-4722
E-mail: membersupport@isc2.org
https://www.isc2.org

The NCWIT is "focused on women's participation in computing across the entire ecosystem, helping 1,400 organizations recruit, retain, and advance women from K-12 and higher education through industry and entrepreneurial careers by providing support, evidence, and action." Visit its Web site for more information.
National Center for Women & Information Technology
1909 26th Street, 2nd Floor
Boulder, CO 80302-5707

Tel: (303) 735-6671
E-mail: info@ncwit.org
https://www.ncwit.org

For information on certification, contact
Network Professional Association
3517 Camino Del Rio South, Suite 215
San Diego, CA 92108-4098
Tel: (888) 672-6720
http://www.npa.org

For industry information, contact
Software & Information Industry Association
1090 Vermont Avenue, NW, Sixth Floor
Washington, D.C. 20005-4905
Tel: (202) 289-7442
http://www.siia.net

For industry information, contact
Technology & Services Industry Association
17065 Camino San Bernardo, Suite 200
San Diego, CA 92127-5737
Tel: (858) 674-5491
http://www.tsia.com

Women in Technology offers a broad range of programs, resources, and support to help advance women in the technology industry.
Women in Technology
200 Little Falls Street, Suite 205
Falls Church, VA 22046-4302
Tel: (703) 349-1044
E-mail: staff@womenintechnology.org
http://www.womenintechnology.org

For career and certification information, contact
World Organization of Webmasters
PO Box 584

Washington, IL 61571-0584
Tel: (662) 493-2776
E-mail: membership@webprofessionals.org
http://webprofessionals.org

For information on blockchain technology and a list of its corporate members, contact
Blockchain Association
718 7th Street, NW
Washington, DC 20001-3782
Tel: (202) 715-2270
E-mail: contact@theblockchainassocation.org
https://theblockchainassociation.org

For information on membership, certification, and continuing education, contact
DevOps Institute
751 Park of Commerce Drive, Suite 108
Boca Raton, FL 33487-3626
https://devopsinstitute.com